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TRANSCRIPT OF RECORD.

SUPREME COURT OF THE UNITED STATES

OCTOBER TERM, 1896.

No. 403.

99.

BOYDEN POWER BRAKE COMPANY ET AL., APPELLANTS.

vs.

GEORGE WESTINGHOUSE, JR., AND THE WESTINGHOUSE
AIR BRAKE COMPANY.

No. 404.

116.

GEORGE WESTINGHOUSE, JR., AND THE WESTINGHOUSE
AIR BRAKE COMPANY, APPELLANTS,

vs.

BOYDEN POWER BRAKE COMPANY ET AL.

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT
OF APPEALS FOR THE FOURTH CIRCUIT.

FILED FEBRUARY 20, 1896.

(16,137 & 16,168.)

490

(16,137 & 16,168.)

SUPREME COURT OF THE UNITED STATES.

OCTOBER TERM, 1896.

No. 403.

BOYDEN POWER BRAKE COMPANY ET AL., APPELLANTS,

vs.

GEORGE WESTINGHOUSE, JR., AND THE WESTINGHOUSE
AIR BRAKE COMPANY.

No. 426.

GEORGE WESTINGHOUSE, JR., AND THE WESTINGHOUSE
AIR BRAKE COMPANY, APPELLANTS,

vs.

BOYDEN POWER BRAKE COMPANY ET AL.

ON WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT
OF APPEALS FOR THE FOURTH CIRCUIT.

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a United States Circuit Court of Appeals, Fourth Circuit.

BOYDEN POWER BRAKE COMPANY; GEORGE A. BOYDEN, President; Charles B. Mann, Secretary; William Whitridge, Treasurer, and Boyden Brake Company, Appellants,	} No. —.
<i>versus</i>	
GEORGE WESTINGHOUSE, JR., and THE WESTINGHOUSE AIR BRAKE COMPANY, Appellees.	

Appeal from the circuit court of the United States for the district of Maryland.

b UNITED STATES OF AMERICA, } *To wit:*
District of Maryland,

At a circuit court of the United States for the fourth circuit, in and for the district of Maryland, begun and held at the court-house in the city of Baltimore, on the first Monday of April, being the first day of the same month, in the year of our Lord one thousand eight hundred and ninety-five—

Present: The Honorable Thomas J. Morris, judge of the Maryland district; William L. Marbury, Esq., attorney; Charles H. Evans, Esq., marshal; James W. Chew, clerk—

Among other were the following proceedings, to wit:

GEORGE WESTINGHOUSE, JR., and THE WESTINGHOUSE AIR BRAKE COMPANY	} In Equity.
<i>vs.</i>	
BOYDEN POWER BRAKE COMPANY; GEORGE A. BOYDEN, President; Charles B. Mann, Secretary; William Whitridge, Treasurer, and Boyden Brake Company.	

1 *Bill of Complaint.*

Filed December 12, 1889.

Circuit Court of the United States in and for the District of Maryland. No. — of — Term, 188—.

GEORGE WESTINGHOUSE, JR., and THE WESTINGHOUSE AIR BRAKE COMPANY	} In Equity.
<i>versus</i>	
BOYDEN POWER BRAKE COMPANY; CHARLES A. BOYDEN, President; Charles B. Mann, Secretary, and William Whitridge, Treasurer.	

To the honorable the judges of the circuit court of the United States in and for the district of Maryland:

George Westinghouse, Jr., a resident of Pittsburg, Allegheny county, Pennsylvania, and the Westinghouse Air Brake Company, a corporation duly organized under the laws of the State of Penn-

sylvania, and doing business at Pittsburg aforesaid, and both being citizens of said State, bring this their bill of complaint against Boyden Power Brake Company, a corporation organized under the laws of the State of Maryland, and doing business at Baltimore, in said State; George A. Boyden, president of said corporation last named; Charles B. Mann, secretary thereof; and William Whitridge, treasurer thereof—all residing in Baltimore aforesaid, and all being citizens of the State last named.

And thereupon your orators complain and say that George Westinghouse, Jr., one of your orators, was and is the true, original and first inventor of certain new and useful improvement in air valve for power brakes, not known or used before his invention thereof, and not, for more than two years prior to the date of his application for a patent therefor, in public use or on sale.

And your orators further show unto your honors that the said George Westinghouse, Jr., so being the inventor of said improvement, and being a citizen of the United States, made application to the proper department of the Government of the United States for letters patent, in accordance with the then existing laws of Congress, and having duly complied in all respects with the conditions and requisitions of said laws, on the fifth day of October, A. D. 1875, letters patent of the United States No. 168,359, signed, sealed and executed in due form of law, for his invention were issued and delivered to the aforesaid George Westinghouse, Jr., whereby there was secured to him and to his heirs, legal representatives and assigns, for the term of seventeen years from the fifth day of October, in the year A. D. 1875, the full and exclusive right of making, using and vending to others to be used, the said improvement.

And your orators further show that a description or specification of the aforesaid improvement was given in the schedule to the aforesaid letters patent annexed, accompanied by certain drawings referred to in said last-mentioned schedule, and forming part of said letters patent. The said letters patent, and the said specification thereto annexed (which, or an exemplified copy of which, your orators will produce as your honors may direct), were duly recorded in the Patent Office.

And thereupon your orators further complain and say that the said George Westinghouse, Jr., was and is the true, original and first inventor of certain new and useful improvement in fluid-pressure automatic brake mechanism, not known or used before his invention thereof, and not, for more than two years prior to the date of his application for a patent therefor, in public use or on sale.

And your orators further show unto your honors that the said George Westinghouse, Jr., so being the inventor of said improvement, and being a citizen of the United States, made application to the proper department of the Government of the United States for letters patent, in accordance with the then existing laws of Congress, and having duly complied in all respects with the conditions and requisitions of said laws, on the 29th day of March, A. D. 1887, letters patent of the United States No. 360,070, signed, sealed and

executed in due form of law, for his invention, were issued and delivered to the aforesaid George Westinghouse, Jr., whereby there was secured to him and to his heirs, legal representatives and assigns, for the term of seventeen years from the 29th day of March, in the year A. D. 1887, the full and exclusive right of making, using, and vending to others to be used, the said improvement.

And your orators further show that a description or specification of the aforesaid improvement was given in the schedule to the aforesaid letters patent annexed, accompanied by certain drawings referred to in said last-mentioned schedule, and forming part of said letters patent. The said letters patent, and the said specification thereto annexed (which, or an exemplified copy of which, your orators will produce as your honors may direct), were duly recorded in the Patent Office.

And your orators further show unto your honors that prior to the commission of the acts of infringement hereinafter charged, by virtue of said patents and a certain instrument in writing, duly executed and recorded in the U. S. Patent Office, the said recited patents, and the entire right, title and interest therein and thereunder, became and still is duly vested in your orators, as by
4 said patents and instrument in writing, or duly certified copies thereof, ready in court to be produced, will fully and at large appear.

And your orators further show unto your honors that the said patented inventions are so nearly allied in character as to be capable of conjoint as well as separate use in the construction and operation of railway fluid-pressure brake mechanism, and have been so used by the defendants herein.

And your orators further show that they, your orators, have extensively applied the said several improvements to practical use, and have been, and but for the infringement hereinafter complained of, to wit, of claim 7 of patent No. 168,359, and claims 1, 2, 4 and 5 of patent No. 360,070, your orators would still be in the undisturbed possession, use and enjoyment of the exclusive privileges secured by the said letters patent and in the receipt of the profits of the same.

And your orators further show unto your honors, as they are informed and believe, that the said defendants herein named, well knowing all the facts hereinbefore set forth, are now constructing, selling and using railway fluid-pressure brake apparatus in material parts thereof substantially the same in construction and operation as in the said several letters patent mentioned, the exclusive right and privilege to make and use which, and vend the same to others to be used, is thus by law vested in your orators.

And so it is, may it please your honors, that the said defendants, as your orators are informed and believe, without the license of your orators, against their will and in violation of their rights have made, sold and used, and intend to continue still to make, sell and use the said improvements within the — district of Maryland and elsewhere in the United States, and refuse to pay to your orators any of the profits which they have made by such unlawful manu-

facture and use, or to desist from the further infringement of said recited letters patent, all of which acts and doings are in violation of the exclusive rights and privileges so as aforesaid vested in your orators under and by virtue of said recited letters patent No. 168,359 and 360,070, and are contrary to equity and good conscience, and tend to the manifest injury of your orators in the premises.

To the end, therefore, that the defendants may, if they can, show reason why your orators should not have the relief hereby prayed for, and that they may make a full disclosure and discovery of all the matters aforesaid, and upon their corporal oaths and under corporate seal, and according to the best and utmost of their knowledge, remembrance, information and belief, full, true, direct and perfect answer make to the matters and things hereinbefore stated and charged.

And that the said defendants may answer the premises, and that they may be decreed to account for and pay over the income and profits thus unlawfully derived, or which might have been derived from the violation of the rights of your orators, as aforesaid, your orators pray that your honors, upon entering of the decree in favor of your orators against said defendants for infringement, as above prayed for, may also proceed to assess, or cause to be assessed, under your directions, as well the profits or income derived therefrom, as be accounted for as aforesaid, as also, in addition thereto, the damages sustained by your orators by reason of such infringement, and that your honors may increase the actual damages so assessed to a sum equal to three times the amount of such assessment, under the circumstances of the willful and unjust infringement committed by said defendants as hereinbefore set forth; and further, that the said defendants may be restrained from any further violation of the rights of your orators as aforesaid, your orators pray that your honors may grant a writ of injunction issuing from and under the seal of this honorable court, or issued by one of your honors, perpetually enjoining or restraining the said defendants, their clerks, attorneys, servants, agents and workmen, from any further construction, or sale, or use in any manner of said patented improvements or any part thereof, in violation of the rights of your orators as aforesaid. And your orators further pray that a provisional or preliminary injunction be issued, restraining the said defendants from any further infringement of said recited letters patent, pending this cause, and they pray for such other relief as the equity of the case may require and to your honors may seem meet.

May it please your honors to grant unto your orators not only a writ of injunction conformable to the prayer of this bill, but also a writ of subpoena of the United States of America, directed to the said Boyden Power Brake Company, George A. Boyden, Charles B. Mann and William Whitridge, commanding them, on a day certain therein to be named, to appear and answer unto this bill of complaint, and to abide and perform such order and decree in the

premises as to the court shall seem meet and may be required by the principles of equity and good conscience.

GEORGE H. CHRISTY,
Solicitor for Complainant.

UNITED STATES OF AMERICA, }
Western District of Pennsylvania, } ss:

Before me, the subscriber, duly authorized to administer oaths, personally came H. H. Westinghouse, general manager of The Westinghouse Air Brake Company, one of the complainants in the foregoing bill named, who, being duly sworn, deposes and says that, so far as the statements herein contained are within his own knowledge, they are true, and so far as they are derived from the information of others he verily believes them to be true. And he further says that he verily believes the said George Westinghouse, Jr., in said bill named, to be the original, true and first inventor of the new and useful improvements which are described in the letters patent Nos. 168,359 and 360,070 granted to George Westinghouse, Jr., and mentioned in the foregoing bill. And further, that
7 the said deponent verily believes that the title of the said complainants is as set forth in said bill.

H. H. WESTINGHOUSE.

Sworn and subscribed before me this tenth day of December,
A. D. 1889.

H. H. WHITTLESEY,
Notary Public.

[NOTARY'S SEAL.]

Subpoena.

THE UNITED STATES OF AMERICA, }
District of Maryland, } *To wit:*

To Boyden Power Brake Company; Charles A. Boyden, president;
Charles B. Mann, secretary; William Whitridge, treasurer, Greeting:

You are hereby commanded that all excuses and delays set aside you be and appear at the clerk's office of the circuit court
[SEAL.] of the United States for the fourth circuit, in and for the district of Maryland, on the first Monday in January next, to answer unto the bill of complaint of George Westinghouse, Jr., and the Westinghouse Air Brake Company, in said court exhibited against you. Hereof you are not to fail at your peril, and have you then and there this writ.

Witness, the Honorable Melville W. Fuller, Chief Justice of our Supreme Court, the twelfth day of December, in the year of our Lord 1889.

Issued 12th day of December, 1889.

JAS. W. CHEW, *Clerk.*

7a MEMORANDUM.—The defendants are required to enter the appearance in the suit in the clerk's office on or before the first Monday of January next; otherwise the bill may be taken *pro confesso*.

Marshal's Return.

"Summoned the Boyden Power Brake Company, by service of Geo. A. Boyden, president. Summoned Geo. A. Boyden, Chas. Mann and Wm. Whitridge.

GEO. H. CAIRNES,
U. S. Marshal."

7b

Answer.

Filed February 3, 1890.

In the Circuit Court of the United States for the District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WESTINGHOUSE
AIR BRAKE COMPANY

vs.

BOYDEN POWER BRAKE COMPANY; GEORGE A. BOYDEN, President; Charles B. Mann, Secretary; William Whitridge, Treasurer.

In Equity

To the honorable the judges of the circuit court of the United States in — for the district of Maryland:

The joint and several answer of the Boyden Power Brake Company of Baltimore City and of George A. Boyden, Charles B. Mann and William Whitridge to the bill of complaint of George Westinghouse, Jr., and the Westinghouse Air Brake Company against these defendants in this court exhibited.

These defendants now and at all times hereafter saving and reserving to themselves all manner of benefit and advantage of exception to the many errors, insufficiencies and inaccuracies in the complainants' said bill of complaint contained, for answer thereto or unto so much and to such parts thereof as these defendants are advised that it is material to make answer unto, say:

1. They admit that the first-named defendant is a corporation created under the laws of the State of Maryland and doing business in the said State, and that the said Boyden, Mann and Whitridge are, respectively, the president, secretary and treasurer of the said company, and that they reside in the city of Baltimore and are citizens of the State of Maryland.

2. They admit that the said company is engaged in manufacturing and selling a fluid-pressure brake; but they deny that the said brake, or any part thereof, is an infringement on the letters patent issued to the complainants and described in said bill of complaint;

and they deny all the allegations contained in the said bill, except such as may be specifically admitted in this answer.

3. For further answer they deny, on information and belief, that the said George Westinghouse, Jr., was the true and original and first inventor of the apparatus covered by the letters patent mentioned in the said bill; and they further say, on information and belief, that the said apparatus was not an invention when produced by the said George Westinghouse, Jr., and that it was not novel, but that an apparatus substantially identical in character therewith was previously patented in letters patent of the United States granted to George Westinghouse, Jr., on March 5, 1872; and that like apparatus was previously described in the following letters patent of the United States:

No. 138,827 to George Westinghouse, Jr., May 13th, 1873.

No. 144,006 to George Westinghouse, Jr., October 28th, 1873.

9 No. 163,089 to Henry E. Marchand, May 11th, 1875.

No. 166,405 to H. Lansing Perine, August 3, 1875.

No. 168,359 to Geo. Westinghouse, Jr., October 5, 1875.

No. 172,064 to Geo. Westinghouse, Jr., January 11th, 1876.

No. 220,556 to Geo. Westinghouse, Jr., October 14th, 1879.

No. 280,285 to Geo. A. Boyden, June 26th, 1883.

4. And these defendants further answering, on information and belief, say that the said alleged invention was in public use more than two years before the said George Westinghouse, Jr., made any application for letters patent thereon, and that the said George Westinghouse, Jr., actually abandoned the said invention before any application was made.

5. And further answering so much of the said bill as alleged an infringement of the seventh claim of letters patent No. 168,359, they say that the said claim can only be construed as covering the specific construction named in the said claim, and that these defendants do not use the said construction; and that the construction used by these defendants cannot infringe the subject-matter of the said claim, for the reason that it is substantially found in several of the prior patents above cited.

6. And for answer to so much of the said bill as alleges an infringement of the first, fourth and fifth claims of letters patent No. 360,070, these defendants say that the valve used by them does not embody the combination of parts set forth in the said claims and does not infringe any patent included therein.

7. And in respect to the alleged infringement of the second claim in the said letters patent, these defendants say that the said second claim is invalid and should not have been granted, because
10 the combination of parts therein named is inoperative to perform and incapable of performing the function set forth in said claim; and that if the said claim be considered merely as the combination of parts therein set forth and without reference to the function described as performed by it, it is invalid for the reason that the same combination of parts is shown in most of the prior patents above cited, and has been publicly used by the com-

plainants for a long time prior to the date of the said letters patent No. 360,070.

8. And, further, these defendants say that the said second claim is uncertain and ambiguous, and that if the functions which are recited in the said claim should be so construed as amplifying the description of the elements or parts composing the combination as to distinguish this combination from that shown in most of the prior patents above cited, then the defendants say that the said claim is anticipated by the prior letters patent issued to George A. Boyden on June 26, 1883; for the reason that air-brake valves made in accordance with the last-mentioned patent embody the same combination of parts, and will perform the same functions and operate in substantially the same manner as stated in the said second claim.

Wherefore, these defendants humbly pray to be hence dismissed with their reasonable costs and charges in that behalf wrongfully sustained.

[SEAL OF COMP'Y.]

By **BOYDEN POWER BRAKE CO.,**
G. A. BOYDEN, President,
BARTON & WILMER,
COWEN & CROSS,
Solicitors for All the Respondents.

UNITED STATES OF AMERICA, } *To wit:*
District of Maryland,

11 I, George Morris Bond, a commissioner of the United States of America in and for the district of Maryland, do hereby certify that on this 3d day of February, in the year eighteen hundred and ninety, personally appeared before me in my said district, George A. Boyden, and made oath that the matters and things stated in the foregoing answer as of his own knowledge are true, and that the matters and things therein stated as upon information and belief, are true to the best of his knowledge, information and belief.

[COM'R'S SEAL.]

GEORGE MORRIS BOND,
United States Commissioner for the
District of Maryland.

G. A. BOYDEN, President.

Petition and Order Making the "Boyden Brake Company" Party Defendant.

Filed February 10, 1890.

GEORGE WESTINGHOUSE, JR., and THE WEST-
INGHOUSE AIR BRAKE COMPANY

vs.

BOYDEN POWER BRAKE COMPANY; GEORGE
A. Boyden, President; Charles B. Mann,
Secretary, and William Whitridge, Treas-
urer.

In the Circuit Court
of the United States
for the District of
Maryland.

Petition of the Boyden Brake Company.

To the honorable the judges of the circuit court of the United States
for the district of Maryland:

The petition of the Boyden Brake Company respectfully repre-
sents that since the filing of the bill in this cause, the said Boyden

Power Brake Company assigned unto your petitioner all its
11a right, title and interest in the patents mentioned in said bill
of complaint, and also all the property of the said Boyden
Power Brake Company of every kind and description; all its prop-
erty, choses in action and estate of every description whatsoever;
and that it is the successor of the said Boyden Power Brake Com-
pany, and as such is engaged in the manufacture of the fluid pressure
of the brake apparatus mentioned in said bill of complaint, and it
prays this honorable court that it may be substituted as defendant
in said cause, and have leave to answer the said bill of complaint.

And as in duty, etc.

COWEN & CROSS,
BARTON & WILMER, *Solicitors.*

Order.

On the foregoing petition, it is, this 10th day of February, 1890,
ordered by the court that the said Boyden Brake Company be
made party defendant in said cause, and that it have leave to answer
therein.

THOS. J. MORRIS, *Judge.*

11b *Answer of the Boyden Brake Company of Baltimore City.*

Filed February 10, 1890.

WESTINGHOUSE <i>et als.</i>	}	In Circuit Court of United States, District of Maryland.
vs. BOYDEN <i>et als.</i>		

The answer of the Boyden Brake Company of Baltimore City to the bill of complaint in this case.

This defendant adopts the answer of its codefendants as fully as if more specifically replied to, and also the prayer therein contained.

[SEAL.]

THE BOYDEN BRAKE COMPANY
OF BALTIMORE CITY.

COWEN & CROSS,

BARTON & WILMER, *Solicitors.*

Before the subscriber, personally appeared Geo. A. Boyden, the president of the Boyden Brake Company, and made oath in due form of law that the matters and things set forth in the answer above described are true to the best of his knowledge and belief, this tenth day of February, 1890.

R. LYON ROGERS,
U. S. Commissioner for Maryland.

11c

Replication.

Filed March 3, 1890.

United States Circuit Court, District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WEST-
INGHOUSE AIR BRAKE COMPANY

vs.

THE BOYDEN POWER BRAKE COMPANY;
George A. Boyden, President; Charles B.
Mann, Secretary, and William Whitridge,
Treasurer.

No. 321. In Equity.

The replication of George Westinghouse, Jr., and The Westinghouse Air Brake Company, complainants, to the answer of The Boyden Power Brake Company; George A. Boyden, president; Charles B. Mann, secretary, and William Whitridge, treasurer, defendants.

These repliants, saving and reserving to themselves all and all manner of advantage of exception to the manifold insufficiencies of the said answer, for replication thereunto say, that they will aver and prove their said bill to be true, certain and sufficient in the law

to be answered unto; and that the said answer of the said defendants is uncertain, untrue and insufficient to be replied unto by these repliants; without this that any other matter or thing whatsoever in the said answer contained, material or effectual in the law to be replied unto, confessed and avoided, traversed or denied, and not herein replied unto, confessed and avoided, traversed or denied, is true; all which matters and things these repliants are and will be ready to aver and prove, as this honorable court shall direct; and they humbly pray, as *to* and by their said bill they have already prayed.

GEORGE H. CHRISTY,
Solicitor for Complainants.

Pittsburg, Pa., February 28, 1890.

11d *Amendment to Complainants' Original Bill of Complaint, by Consent.*

Filed March 3, 1890.

Circuit Court of the United States, District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WEST-
INGHOUSE AIR BRAKE COMPANY

vs.

BOYDEN POWER BRAKE COMPANY; CHARLES
A. Boyden, President; Charles B. Mann,
Secretary, and Wm. Whitridge, Treasurer.

No. 321. In Equity.

And now, to wit, 3d March, 1890, the complainants above named, by leave of court first had and obtained, amend their original bill of complaint by substituting "claim 7" for "claim 4" in the clause charging infringement of patent No. 168,359.

THOS. J. MORRIS, *Judge.*

Endorsed.

"We consent to the filing of the above amendment.

"BARTON & WILMER."

Appearance for Complainants.

Filed July 7, 1890.

GEORGE WESTINGHOUSE, JR., ETC.,

vs.

BOYDEN POWER BRAKE COMPANY *et al.*

{ Circuit Court U. S. In
Equity. No. 321.

Mr. Chew:

Enter my appearance as solicitor for complainants.

BERNARD CARTER.

12 *Appearance for Complainants.*

Filed November 21, 1893.

GEORGE WESTINGHOUSE, JR., *et al.* } U. S. Circuit Court, Dis-
vs. } trict of Maryland.
 BOYDEN POWER BRAKE COMPANY *et al.* }

PITTSBURGH, November 18, 1893.

James W. Chew, Esq., clerk U. S. circuit court, dist. Maryland,
 Baltimore, Md.

DEAR SIR: Please enter my appearance of counsel for complain-
 ants in above-entitled cause.

Very truly yours,

J. SNOWDEN BELL.

13 United States Circuit Court, District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WEST- }
 INGHOUSE AIR BRAKE COMPANY }
vs. }
 BOYDEN POWER BRAKE COMPANY; CHARLES } In Equity. No. 321.
 A. Boyden, President; Charles B. Mann, Sec- }
 retary, and William Whitridge, Treasurer. }

Depositions of witnesses and other evidence on behalf of complain-
 ants in above-entitled cause, under 67th rule in equity as
 amended, pursuant to notice and stipulation, before R. H. Whit-
 tlesey, special examiner, at the Hotel Albert, corner of Eleventh
 street and University place, in the city of New York, commenc-
 ing at 10.30 o'clock a. m. on Tuesday, July 14th, 1891.

Present: J. Snowden Bell, Esq., of counsel for complainants, and
 Lysander Hill, Esq., of counsel for defendants.

It is stipulated and agreed that the defendant corporation has
 made, used, and sold, prior to the filing of the bill in this cause,
 and subsequent to the issue of the several letters patent sued on,
 and is now making, using and selling quick-action triple valves,
 of which Complainants' Exhibit Defendants' Quick-action Triple

Valve is a specimen, and which are substantially shown and
 14 described in plate XI of Complainants' Exhibit Defendants'
 1891 Catalogue and the descriptive matter relating thereto.

Also, that Complainants' Exhibit Defendants' 1891 Catalogue
 is a catalogue issued and circulated by the defendant corporation.

Also, that printed Patent Office copies of United States letters
 patent and Blue Book copies of British letters patent, printed by
 the respective governments, may be referred to and offered in evi-
 dence by either party, without certification, with the same force and
 effect as if certified.

The several exhibits above specified are offered and put in evi-
 dence by counsel for complainants, and are marked as above stated.

It is further stipulated and agreed that the complainants' title is as set forth in the bill; copies of the instruments in writing making out the title to be offered in evidence prior to closing complainants' *prima facie* case.

It is further stipulated and agreed that the testimony of each party may be taken before any notary public not disqualified, and that complainants' testimony may be taken by R. H. Whittlesey, notary public, as special examiner, with the same force and effect as before a standing examiner of court or a special examiner duly appointed, and that an order to such effect may be entered, *nunc pro tunc*, at or before the hearing, and that a similar order may be entered, *nunc pro tunc*, with respect to the notary or notaries public to be selected by the defendants for the taking of their testimony.

It is also stipulated that all testimony shall be taken in long-hand or in typewriting, without the aid of a stenographer.

Counsel for complainants offers and puts in evidence a printed Patent Office copy of letters patent No. 360,070, to George Westinghouse, Jr., for improvement in fluid-pressure automatic brake mechanism, dated March 29th, 1887, and the same is marked "Complainants' Exhibit Patent 360,070," R. H. Whittlesey, special examiner.

HENRY F. NEWBURY, a witness produced on behalf of complainants, being duly sworn, deposes and says, in answer to interrogatories proposed to him by J. Snowden Bell, Esq., of counsel for complainants, as follows, to wit:

Int. 1. State your name, age, residence and occupation.

A. Henry F. Newbury; age, 49; residence, 142 Park place, Brooklyn, N. Y.; am at present manager of the time-lock department of the Holmes Burglar Alarm Telegraph Company, whose office is 518 Broadway, New York city, and am a machinist by trade.

Int. 2. State the nature and extent of your mechanical experience and your experience in connection with questions relating to letters patent for inventions.

A. When a young man I learned the trade of a machinist, and have worked more or less at that trade until within a short time. While so engaged I became familiar with the use of tools and machinery and the working of metals, as well as the application of mechanical principles in the construction and operation of machinery of different kinds.

I also became familiar with the making and reading of mechanical drawings and have made many such drawings, as well as superintending the making of other drawings. While working at my trade I have had frequent occasion to design and construct, as well as superintend, the construction of various mechanisms relating to different manufactures.

For the past twelve years or more I have devoted a very large proportion of my time to the study of matters relating to patents and patented inventions, and while so engaged I have read the

specifications and drawings of large numbers of letters patent, both of the United States and foreign countries to learn wherein they resembled or differed from other mechanisms shown and described in other patents or embodied in concrete form to enable me to point out such differences or resemblances.

I have very frequently for the past five years or more been called upon to testify as an expert witness in the United States courts, and, while so engaged, been called upon to point out resemblances and differences in patented mechanisms or structures therein in controversy, and I may say for this period of time almost my entire attention has been given to patents and patented structures.

Int. 3. Have you examined and do you understand letters patent No. 360,070, granted and issued to George Westinghouse, Jr., for improvement in fluid-pressure automatic brake mechanism, dated March 29th, 1887, "Complainants' Exhibit Patent 360,070"?

A. I have frequently read and carefully studied a printed Patent Office copy of the letters patent mentioned in the question, and I believe I understand the construction and operation of the mechanism therein shown, described and claimed.

Int. 4. Please describe briefly and generally the construction and operation of the mechanisms or devices described and shown in said letters patent, so far as the same may be necessary to a full understanding of the combinations of devices recited in the first, second and fourth claims thereof.

A. The specification of the said letters patent No. 360,070 refers to the object of the invention therein shown and described in the following language:

"The object of my invention is to enable the application of brake-shoes to car wheels by fluid pressure, to be effected with greater rapidity and effectiveness than heretofore, more particularly in trains of considerable length, as well as to economize compressed air in the operation of braking by utilizing in the brake-cylinders the greater portion of the volume of air which in former practice was directly discharged into the atmosphere.

"To this end my invention, generally stated, consists in a novel combination of a brake-pipe, an auxiliary reservoir, a brake-cylinder, and a 'triple-valve' device governing, primarily, communication between the reservoir and the brake-cylinder, and, secondarily, communication directly from the brake-pipe to the brake-cylinder."

The specification then goes on and describes in general terms the Westinghouse automatic brake as it had theretofore existed, and the difficulties encountered when applied to trains of considerable length, such as are used many times in what is known as freight service.

This description and reference is as follows:

"In the application of the Westinghouse automatic brake, as heretofore and as at present commonly in use, each car is provided with a main air pipe and auxiliary reservoir, a brake-cylinder, and a triple valve, the triple valve having three connections—to wit, one to the main air-brake pipe, one to the auxiliary reservoir, and

one to the brake-cylinder. The main air pipe has a stop-cock at or near each of its ends, to be opened or closed as required, and is fitted with flexible connection and couplings for connecting the pipes from car to car of a train, so as to form a continuous line for the transmission of compressed air from a main reservoir supplied by an air pump on the engine.

"When the brakes are off or released, but in readiness for action upon the wheels of the train, the air which fills the main reservoir and main air pipes has a pressure of from sixty-five to seventy-five pounds to the square inch, and by reason of the connections referred to, the same pressure is exerted in the casings of the triple valves on both sides of their pistons and in the auxiliary reservoirs connected therewith. At the same time passages called 'release ports' are opened from the brake-cylinders to the atmosphere. When it is desired to apply the brakes, air is allowed to escape from the main air pipe through the engineer's valve, thereby reducing the pressure in the main air pipe, whereupon the then higher pressure in the auxiliary reservoirs moves the pistons of the triple valves, so as to first close the passages from the triple valves to the brake-pipe,

and at the same time close the release ports of all the brake-cylinders, and then open the passages from the auxiliary reservoirs to the brake-cylinders, the pistons of which are forced out by the compressed air thereby admitted to the brake-cylinders, applying the brakes by means of suitable levers and connections, all of which mechanism is fully shown in various letters patent granted to me.

"The application of the brakes with their full force has heretofore required a discharge of air from the main pipe sufficient to reduce the pressure in said pipe below that remaining in the auxiliary reservoir after the brakes had been fully applied, and it has been found that, while the brakes are sufficiently quick in action on comparatively short trains, their action on long trains of from thirty to fifty cars, which are common in freight service under present practice, is in a measure slow, particularly by reason of the fact that all the air required to be discharged from the main pipe to set the brakes must travel from the rear of the train to a single discharge opening on the engine. This discharge of air at the engine has not only involved a serious loss of time in braking, but also a waste of air. Under my present invention a quicker and more efficient action of the brakes is obtained, and air which has been heretofore wasted in the application of the brakes is almost wholly utilized to act upon the brake-pistons."

The specification then goes on to state "That, in the practice of my invention, each railroad car, 1, on which it is applied is, as heretofore, provided with a main air pipe, 2, governed by stop-cocks, 3, adjacent to its ends, and having a flexible connection, 4, and coupling, 5, at each end, to admit of being coupled to the main air pipe of the tender, or the adjacent car or cars of a train. (See figure 1 for the arrangement of parts mentioned above, as well as those just following.) An auxiliary reservoir, 6, and brake-cylinder, 7, are secured in convenient position below the sills of the car, the

brake-cylinder having a piston, 52 (see Fig. 7), by the movement of which, through a system of lever connections, which do not form part of my present invention, the brake-shoes, 9, are applied to and released from the wheels of the car, compressed air being supplied to and released from the brake-cylinder, 7, as the pressure in the main air pipe is reduced or reinstated respectively, by means of a triple valve, 10, the casing or chest of which communicates with the main air pipe, the auxiliary reservoir, and the brake-cylinder.

"So far as the performance of its preliminary function in ordinary braking is concerned, that is to say, effecting the closure of communication between the main air pipe and the auxiliary reservoir, and the opening of communication between the auxiliary reservoir and the brake-cylinder in applying the brakes, and the reverse operations in releasing the brakes, the triple valve, 10, accords substantially with that set forth in letters patent of the United States No. 220,556, granted and issued to me October 14, 1879, and is not, therefore, saying as to the structural features by which it performs the further function of effecting the direct admission of air from the main air pipe to the brake-cylinder, as presently to be described, claimed as of my present invention. Certain of its elements devised and employed by me prior thereto will, however, be herein specified, in order to render its construction and operative relation to other members of the brake mechanism fully intelligible."

Briefly stated, a triple valve, in general, contains a piston chamber in which a piston works, which chamber is open to, or in commu-

(At this point of the examination the expert states that he desires to make use of notes he has prepared, and counsel for defendants makes no objection.)

nication with, the main air or train pipe pressure on one side and the auxiliary reservoir pressure on the other side, so that upon an increase of such pressure in such pipe over that in the auxiliary reservoir, such increased pressure will act upon one side of the piston and force it forward until it is met by an opposing force equal to or greater than that which moved it, when it will come to a stop, and upon a diminution or reduction of such fluid pressure in the main air or train pipe below that in the auxiliary reservoir, the piston will move backward or in an opposite direction by reason of the preponderance of auxiliary reservoir pressure over that of the main air or train pipe side of the piston. From this it will be seen that the piston will be moved in opposite directions by varying the fluid pressure in the main air or train pipe, and thus the triple valve is controlled accordingly as the pressure in the main air or train pipe is controlled. It will also be seen that, when the pressure upon the opposite sides of the triple-valve piston is equal, that such piston will be held in a state of rest until the equilibrium of pressure is disturbed, when it will move in the direction of least resistance or pressure until the equilibrium is again established or a greater resistance is met.

For convenience I will call the movement of the piston by reason of an increase of fluid pressure in the main air or train pipe, its forward movement or stroke; and the movement of it by a decrease of pressure in the main air or train pipe, its backward movement or stroke; and also I will term the fluid pressure in the main air or train pipe, the main air or train pipe pressure, and that in the auxiliary reservoir, the auxiliary reservoir pressure.

The piston chamber and piston of the triple valve illustrated in the drawings of patent 360,070 are designated by the numerals 11 and 12 respectively, and the piston is there shown at the extreme limit of its forward movement or stroke.

Means are provided in triple valves whereby fluid pressure in the main air or train pipe, or main air or train pipe pressure, is permitted to pass by or through the piston so as to reach both sides thereof and act thereon. Usually such passage of fluid pressure takes place only when the piston is very near its limit of forward movement, so that upon a reduction of pressure in the main air or train pipe below that in the auxiliary reservoir, the passage of fluid pressure from one to the other, in either direction, will be stopped shortly after the beginning of the backward movement of the piston, and the pressure already in the

auxiliary reservoir is prevented from returning to the main air or train pipe by reason of the closing of such passages by the backward movement of the piston. The means usually employed for this purpose consist of a valve placed in the piston, which is opened by the main air or train pipe pressure and closed by auxiliary reservoir pressure, or a valve which is opened, or an opening which is uncovered by the movement of the piston itself as it nears the limit of its forward movement or stroke, and is closed or covered by the piston upon the beginning of its return or backward movement or stroke.

In the case last mentioned the valve is usually placed in the piston itself and the opening is located in the wall of the piston chamber at the edge of the piston and extending around from one side to the other of it when the piston is at the limit of its forward movement or stroke.

The piston is provided with a valve which controls a suitable opening or port leading from the auxiliary reservoir to the brake-cylinder, which port or opening is usually closed while the piston is passing through the last half or more of its forward movement or stroke, and is opened by the backward movement or stroke of the piston.

The piston is also provided with another valve which controls another opening or port leading from the brake-cylinder to the open atmosphere or other desired place of exhaust or escaping fluid pressure from the brake-cylinder. This second valve or opening or port is arranged relatively to the piston, so that the piston causes the valve to open the port or opening from the brake-cylinder to the atmosphere or other place of exhaust when the piston is near or at the end of its forward movement or stroke.

From the above it will be seen that the opening or port leading

from the auxiliary reservoir to the brake-cylinder is always closed when the opening or port from the brake-cylinder to the atmosphere is open and *vice versa*, and also that both of the ports or openings may be closed during a portion of the movement or stroke of the piston.

In many constructions of triple valves, the above two valves connected with the piston and moved thereby are composed of one piece of material which contains suitable recesses to connect the two portions of the ports or openings in the valve chamber or its casing between the points named above, that is, from the auxiliary reservoir to the brake-cylinder and from the brake-cylinder to the open atmosphere or elsewhere. Such is the case in the form illustrated in the drawings of patent No. 360,070, and therein designated by the numerals 14, and which is of the sliding type, and it is held to its seat against one side of the valve chamber constructed in the bushing 24, by a spring resting against the opposite side of such chamber. For convenience, this valve may be termed a main or primary valve because it performs the main or primary functions in applying and releasing the brakes, and is known as a slide-valve. This slide-valve 14, is moved or controlled by a collar 27, and shoulder 28, on the piston stem 13, of the piston 12, as will be seen by referring to the drawings of said patent. The valve chamber in the bushing 24 is in open communication with the auxiliary reservoir through its open end opposite the piston chamber 11, and it is also in communication with the brake-cylinder through the ports or openings 22 and 23 and the passage 16 leading to such cylinder, when the recesses 35 or 31 in valve 14, are in register or communication with the port 23, as one or the other will be during a part of the latter portion of the backward movement or stroke of piston 12. The brake-cylinder is in communication with the release, escape, or exhaust port 15 (see Fig. 2) through passages or openings 16, 22, 23 and 34, when the valve 14 and piston 12 are at or near the extreme limit of their forward movement or stroke, by reason of the recess 33 in such valve furnishing an open passage between ports or openings 33 and 34.

The slide-valve 14 is shorter in length than the distance between the shoulder 28 and collar 29 on the piston stem 13, and because of this fact the piston 12 and its stem 13 have a movement relatively to the valve 14. A second stem with a valve 29 is attached to the stem 13 so as to be parallel therewith. Valve 29 has its seat in the slide-valve 14, so that it opens and closes the port or passage 31 leading through the valve 14, and the movement of the stem 13 and the valve 29 attached thereto relatively to the valve 14, permits the opening and closing of the valve 29 without moving the valve 14, except when the move stem 13 exceeds the space between the ends of the valve 14 and collar 29 and shoulder 28 on stem 13, thus relieving the piston of the friction of the valve 14, and rendering the piston 12 more sensitive to slight variations in pressure.

The piston chamber 11 is also in open communication with the main air or train pipe through the passages 17 and 18, leading into

the chamber of the drain-cup portion 19 of the triple-valve casing, and thence through passages 20 to the piston chamber 11.

Arranged axially with the piston 12 and its stem 13 there is another stem 36 fitted in bearings so as to slide freely in the direction of its length, and upon which there is placed a spring 39, which bears at one end against the extreme end of the drain-cup 19, and at its other end against a collar 40 on the stem 36, which collar in turn bears against a bushing 37, arranged in the end of the drain-cup nearest the piston chamber 11. The collar 40 limits the movement of the stem 36 in the direction of the movement of the piston 12, so that there is a space between the end of such stem and a central projection on the piston 12, when the piston is at or near its extreme forward part of its movement, which space is lessened as the piston 12 moves towards the limit of its backward movement or stroke until the projection on the piston 12 comes in contact with the forward end of stem 36 and moves it backward with it through

the greater portion of the latter half of the backward movement or stroke of the piston, the compression of the spring 39 permitting the stem 36 and collar 40 to move backward with it.

One object of the stem 36 and spring 39 is to prevent the piston 12, when once it starts on its backward movement or stroke, from continuing further than necessary to bring the port or passage 31, in valve 14, in register with the ports and passages 23, 22 and 16, so that auxiliary reservoir pressure can pass into the brake-cylinder when ordinary braking purposes are to be served, as fully set forth in patent 220,556, heretofore referred to. The other object of the stem 36 will be hereafter explained.

The above describes the construction of "triple valves" in general, and also the particular one illustrated in the drawings of the patent in suit.

In reference to the meaning of the term "triple valve," as used in connection with the patent in suit, the specification states that—

"In using the terms 'triple valve' and 'triple-valve device,' I refer to a valve device, however specifically constructed, having a connection with the main air or brake pipe, another with an auxiliary reservoir or chamber for the storage of power, and another with a brake-cylinder, or its equivalent, for the utilization of the stored power, and with a release or discharge passage for releasing the operative power from the brake-cylinder, whether the valves governing these passages or connections are arranged in one or more cases, and are moved by a piston or its equivalent, or by a series of pistons or their equivalents, there being numerous examples in the art, of constructions varying materially in appearance, whereby these functions are performed, both in plenum and vacuum mechanisms."

From the above statement I understand that the form of "triple valve" illustrated in the drawings of the patent in suit is the preferred form, but that any form may be used that the constructor sees fit to adopt in making up the combinations of devices particularly pointed out in the claims named in the question, so long as

25 such "triple valve" has the three connections and the three-fold functions heretofore referred to, or, in other words, that the particular form which such "triple valve" may take is wholly immaterial, so long as it performs the functions of a "triple valve" as heretofore set forth.

I will now describe those features of construction which, taken in connection with a "triple valve," as defined just above, go to make up the combinations of devices recited in the several claims in the patent in suit and referred to in the present question.

For the purpose of effecting the admission of air from the main air or train pipe to the brake-cylinder when it is desired to apply the brakes with great rapidity and with full force, as, for instance, when a collision or other accident is to be avoided, an auxiliary valve 41 is connected to and moves with the stem 36, which valve, as the stem 36 is moved backward by the contact or connection of the piston 12 with it, as such piston nears its extreme limit of backward movement, uncovers or opens a port or passage 42 in the bushing 37, which opens into a chamber 43, which in turn connects by a passage 46, (Fig. 5) with a chamber 47, in the end of the triple-valve casing adjacent to the auxiliary reservoir. From this latter chamber 47 a passage 48 leads through the auxiliary reservoir to the brake-cylinder. The chamber 43, in the preferred form, is provided with a check-valve 49, which is held to its seat by a spring 50.

This check valve 49 is arranged so that it is opened by main air or train pipe pressure as it enters chamber 43, whenever such pressure exceeds that of spring 50 and the pressure in the brake-cylinder, and allows it to pass to and through the passage 46, but it is closed whenever the pressure in the brake-cylinder, with the spring 50, exceeds that of the main air or train pipe pressure. From this it results that whenever the train breaks in two, or from any other cause, the pressure is allowed to fully escape from or be greatly reduced in the main air or train pipe, the brakes will be applied by the pressure from the auxiliary reservoir being held in the brake-cylinder by the check-valve 49.

26 When the piston 12 is at the extreme limit of its backward movement or stroke, and the stem 36 has opened or uncovered the port or passage 42 by the backward movement or stroke of the valve 41, there is practically an open passage from the main air or train pipe to the brake-cylinder, through the ports or passages and chambers 17, 18, 20, 11, 42, 43, 46, 47 and 48, so that main air or train pipe pressure can, under certain conditions, pass directly to the brake-cylinder, thereby reducing the pressure in the main air or train pipe and at the same time utilizing it in the brake-cylinder for braking purposes, which results in the application of the brakes to the cars of the whole train in a much shorter time than possible with any other automatic system or construction wholly actuated by fluid pressure before known.

Because of such application of the brakes in a shorter or quicker time, "triple valves" having this capacity of admitting main air or train pipe pressure directly to the brake-cylinder upon the com-

mencement of the application of the brakes, or systems where this result is accomplished, have become known in the art as "quick-action triple valves" or "automatic quick-action systems" of brakes.

Such "quick-action triple valves" or "automatic quick-action systems" of brakes perform three classes of work: First, what is known as "graduating," which is the introduction of an amount of fluid pressure less than the maximum to the brake-cylinders, which will apply the brake-shoes to the wheels of the train with the amount of force which will suffice to prevent the speed of the train from increasing on a downgrade, or reducing the speed of the train when a stop is not to be made, the amount of pressure varying according to the weight of the train, its speed, and the downgrade over which it is passing, or, in other words, the amount of pressure admitted to the brake cylinders is "graduated" according to the circumstances of each particular case.

Second, what are known as "service stops," such as stopping
27 at stations and elsewhere when there is plenty of time, and the least shock or wear and tear on rolling stock is desired; and—

Third, what are known as "emergency stops," that is, stops where collisions or other accidents are to be avoided, and they are to be made in the shortest space of time regardless of other considerations.

The first two classes of work are performed more or less perfectly by all known forms or constructions of "triple valves," and the patents numbered 168,359, 172,064 and 220,556, mentioned specifically in the patent in suit have to do with a more perfect performance of said first two classes of work as therein respectively set forth.

The present invention or the invention of the patent in suit has to do with the combining of certain devices with the old automatic system, by means of which the addition or "further function" requisite for "quicker and more efficient action of the brakes is obtained," which function covers the third class of work above referred to, viz., "emergency stops," and these three classes of work are performed when occasion requires, by the use of substantially the same means, each class of work being performed as desired by simply varying the manner of using such means.

The class of work to be performed by the "automatic quick-action system of brakes," or "quick-action triple valves," is determined either by the amount of fluid pressure allowed to escape at the engine from the main air or train pipe or the manner in which such pressure is allowed to escape, or both taken together, as for instance, when "graduating" or holding a train in check on a downgrade or reducing its speed for any reason, is the class of work to be performed, a comparatively small amount of fluid pressure is allowed to escape at a time so that the amount of such pressure which escapes from the auxiliary reservoirs to such cylinders in the operation of equalizing the pressures between such reservoirs and train-pipe, applies the brake-shoes to the wheels of the cars with the desired amount of force. If the first amount of such pressure re-

28 ceived by the brake-cylinders is insufficient, a second and augmenting amount can be allowed to enter from the auxiliary reservoirs by a still further slight escape from the main air or train pipe, and so on until the desired amount is obtained for holding the train in check or reducing its speed to the desired extent. Again, if the class of work required is a "service" or station stop, a somewhat greater amount of fluid pressure than when graduating is allowed to escape at the engine from the main air or train pipe, but it is allowed to escape gradually, so that the pressure in such pipe decreases as the pressure in the auxiliary reservoirs decreases, the difference in fluid pressure in the auxiliary reservoirs and main air or train pipe remaining about the same, the pressure in each decreasing in like ratio. Or if the train is desired to be stopped more slowly a series of "graduation" applications, or reductions in the pressure in the main air or train pipe can be made and any desired slowness of stoppage of the train can be obtained.

Or again, if the class of work required is an "emergency" stop, when a collision or other accident is to be avoided, then the same or a somewhat less amount of fluid pressure than in making a service stop is allowed to escape at the engine from the main air or train pipe in the shortest possible time, which results in opening communication through each and every quick-action triple valve between the main air or train pipe and the corresponding brake-cylinders throughout the train, and a still further escape of fluid pressure from such pipe at each of such valves to each one of the brake-cylinders is obtained, to be there utilized in applying the brakes. In this latter class of work, that is, making "emergency stops," the quickness with which the pressure is allowed to escape at the engine from the main air or train pipe, determines, in a measure, the amount of fluid pressure which can escape from such pipe before the pressure in the brake-cylinders equals that of the pipe and prevents further escape therefrom to the brake-cylinders.

29 At or about the time fluid pressure from the main air or train pipe is entering the brake-cylinders, fluid pressure from each one of the auxiliary reservoirs is also simultaneously entering its corresponding brake-cylinder, and in order that the greatest amount possible of the pressure in such pipe shall escape therefrom and enter the brake-cylinders, it is necessary that such cylinders be substantially free from pressure at the beginning of such escape so as to permit the pressure in the pipe to be reduced to the lowest extent before the combined pressures from the main air or train pipe and the auxiliary reservoir, in the brake cylinders, equal that remaining in the pipe, and preclude the further escape from the pipe to the cylinders, as the escape ceases on the approach of an equilibrium between the pressures in the cylinders and the pipe.

From the above it follows as a necessity that the fundamental or underlying principle of the "automatic quick-action system" of brakes, requires that the brake-cylinders be substantially free from pressure, and that the escape of fluid pressure from the main air or train pipe at the engine, be quick and considerable in extent,

so that communication between the main air or train pipe and the brake-cylinders be opened almost instantaneously, and before any substantial opposing pressure has entered the cylinders from the auxiliary reservoirs to interfere with the escape of pressure from the main air or train pipe to such cylinders.

The quickness of action of the brakes on succeeding cars, as well as the increased force with which the brakes are applied, depends almost wholly upon the amount of fluid pressure escaping from the main air or train pipe into the brake-cylinder of each preceding car.

To illustrate, we will assume that the relative proportions of all the parts are such as will give the following results, which are approximately those obtained in actual practice in some systems where "quick-action triple valves" are used. When the fluid pressure in the main air or train pipe is seventy pounds to the square inch and an emergency stop is to be made, the auxiliary
30 reservoir pressure, owing to the connection between them and the main air or train pipe, will also be seventy pounds, as the two pressures equalize through such connection. Then the engineer allows twenty pounds to quickly escape from the main air or train pipe by means of his operating cock or valve, and opens communication between the main air or train pipe and the brake-cylinder of the first quick-action triple valve, or such valve nearest the engine, when the pressure in such pipe adjacent to such valve is almost instantaneously reduced to about forty pounds, such reduction of pressure entering the cylinder, and it is sufficient to exert a pressure therein of about twenty-five pounds, which, with the pressure from the auxiliary reservoir, entering simultaneously, or nearly so, with that from the main air or train pipe, balances or equalizes the pressures in the cylinder and pipe, and further escape from such pipe at that point ceases.

Adjourned to meet at same place, tomorrow, Wednesday, July 15th, 1891, at eleven o'clock a.m.

R. H. WHITTLESEY,
Special Examiner.

NEW YORK, N. Y., July 15, 1891

Met pursuant to adjournment.

Counsel present as at yesterday's meeting.

The witness, HENRY F. NEWBURY, continues his answer to Int. 4:

This reduction of pressure to forty pounds in the main air or train pipe adjacent to the first triple valve causes the second triple valve to open communication between such pipe and the second brake-cylinder, and cause a second escape like that at the first triple valve, and this is repeated in succession until the end of the
31 train is reached and the pressure in the entire pipe throughout the train is reduced to about forty pounds, and each brake-cylinder has received a pressure from such pipe of about

twenty-five pounds without the fluid pressure traveling from one end of the train to the other, each reduction being adjacent to its point of escape and the quickness of the application of the brakes on the several cars being in proportion to the amount of escape of fluid pressure from such main air or train pipe. The maximum equalized pressure in the auxiliary reservoirs and cylinders, when a service or station stop is made, and no pressure is received directly from the main air or train pipe, is about fifty pounds; and it will be readily seen that the equalized pressure in the case of an emergency stop, when the brake-cylinders have received a pressure of about twenty-five pounds from such main air or train pipe, will be considerably higher than it would be if no pressure had been received from the main air or train pipe, and such equalized pressure in the case of an emergency stop is about sixty pounds to the square inch instead of about fifty pounds when a service stop is made; or, in other words, the brake-shoes are applied to the wheels of the cars with about ten pounds more force in case of an emergency stop than when a service stop is made. In the above illustration I have used round numbers for convenience; but, as before stated, they approximate actual results in practice.

With the above understanding of the operation of triple valves, when used in the "automatic quick-action" system of brakes in general, I will describe the operation of the preferred form illustrated in the drawings and which I have fully described the construction thereof.

Compressed air is the fluid designed to be used in such preferred form as is stated in those portions of the specification which I have heretofore quoted.

To aid in the said description, I will make reference to a drawing on an enlarged scale showing the arrangement of the quick-action triple valve, auxiliary reservoirs, and brake-cylinder, and the several connections to which I have heretofore referred, which arrangement will be found in that portion of the drawing designated as Fig. 1. Figure 2 on the same drawing represents a sectional view of the triple valve and its connection to the main air or train brake-pipe, taken on a different line from that on which corresponding portions are shown in Fig. 1, the object being to more clearly show the construction and arrangement of the auxiliary-valve device, by means of which communication is opened directly from the main air or train pipe into the brake-cylinder. I will place on the said drawing the same designating characters that are found on the patent in suit.

I will hereafter and before the close of my present deposition produce a cut or drawing showing the general arrangement of the air-compressing device and other parts located upon the engine, as well as one of the old forms of triple valves, and also one form of quick-action triple valve of the patent in suit, as the same are arranged in actual practice, so as to show the connections between the locomotive and train.

For convenience I will describe the operation of this automatic quick-action system of brakes when performing the two first classes

of work heretofore referred to—namely, “graduating” and “service” stops—together.

The drawing referred to by the witness is here offered and put in evidence by counsel for complainants and is marked “Complainants’ Exhibit Drawing Complainants’ Quick-action Triple Valve and Connections, R. H. Whittlesey, special examiner.”

In the operation of such automatic quick-action system of brakes, as the same is illustrated in the drawing of the patent in suit, air from the main reservoir and main air or train pipe passes through passages 17, 18, chamber in drain-cup 19, and passages 20, into the piston chamber 11, forcing the piston 12 forward to the extremity of its movement or stroke in that direction and uncovering a small feeding groove or opening 51 in the piston chamber, leading around the piston, through which compressed air or fluid pressure passes into auxiliary reservoir 6 until the pressure in the latter is equal to that in the main air or train pipe, the brake-cylinder meanwhile being in communication with the atmosphere through passages 16 and 22, recess or opening 33 in valve 14, and ports 23, 34 and relief or exhaust port 15. To apply the brakes in making service or other ordinary stops, a portion of the air or pressure is discharged from the main air or train pipe by the engineer’s valve, thereby reducing the pressure in said main air or train pipe, whereupon the higher or greater pressure in the auxiliary reservoir moves the piston 12 backward a portion of its stroke, closing or covering the opening or feeding groove 51, and thus preventing the return of air or pressure from the auxiliary reservoir to the main air or train pipe, the movement of the piston continuing until arrested or stopped by the decrease of pressure in the auxiliary reservoir or by its contact with the stem 36 and its spring 39.

This movement of the piston 12 backward, under the conditions and to the extent just named, may be termed its first or preliminary movement or traverse.

The movement of the slide-valve 14 then closes the port 23, preventing escape of air or pressure from the brake-cylinder, and places the passage 31 partly or wholly in communication or register with the recess or opening 33.

The valve 29, which opens and closes the passage 31 in the valve 14, having been meanwhile unseated by the movement of the piston stem 13, opens such passage so that compressed air or pressure from the auxiliary reservoir passes through port 32 and passage 31 of the slide-valve 14, and the passages 22 and 16 of the triple-valve casing or chest to the brake-cylinder, forcing out the piston of such cylinder and through an appropriate system of levers and connections applying the brakes to the cars. When the pressure in the auxiliary reservoir has in this operation been reduced by expansion into the brake-cylinder until it is slightly below the pressure in the main air or train pipe the pressure on the main air or train pipe side of the piston 12, forces such piston in the opposite or forward direction until the valve 29 closes the passage 31, thereby arresting or stopping the further flow or expansion of air or pressure

from the reservoir to the brake-cylinder and holding the brakes with a force proportionate to reduction of pressure in the main air or train pipe.

To release the brakes, the pressure in the main air or train pipe is increased by admitting pressure or air from the main reservoir located upon the engine, whereupon the resultant increase of pressure in the piston chamber 11 forces the piston forward to the extreme limit of its stroke in that direction, permitting the escape of air from the brake-cylinder 7. The piston 52 of such cylinder is returned to its former position by a spring 53, releasing in such movement the brake-shoes 9 from the wheels, and at the same time the auxiliary reservoir is recharged. The admission of fluid pressure or air to the brake-cylinder through the passage 31, in the valve 14, which is opened just before the piston stem 13 comes in contact with graduating stem 36, and which corresponds to the feeding passage heretofore employed, suffices for all ordinary requirements for applying the brakes in regular service, that is, the first two classes of work heretofore referred to are performed by the operation of the triple valve, as just heretofore described.

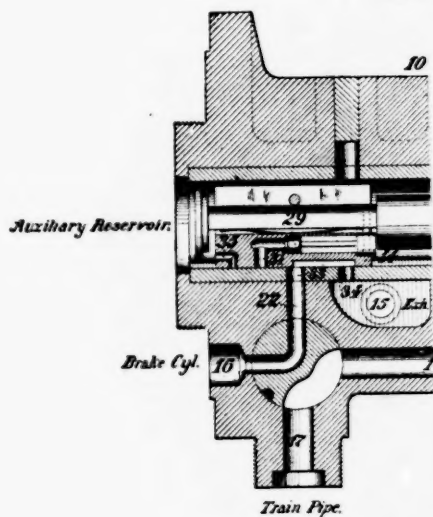
(Here follow diagrams marked pp. 34a & 34b.)

In the event, however, of its becoming necessary to apply the brakes with great rapidity and with the greatest available force, as for instance, when an "emergency stop" is to be made, the engineer, by means of the operating valve at his command, instantly discharges sufficient air from the front end of the main air or train pipe to effect a sudden reduction of pressure therein, as heretofore described, whereupon the piston 12 is forced to the extreme limit of its backward movement or stroke, carrying with it the stem 36, and
 35 auxiliary slide-valve 41, which instantly opens or uncovers the port or opening 42, and opens communication between the main air or train pipe and brake-cylinder through the opening in the check-valve 49 and the passages 46, 48, leading thereto, and permitting fluid pressure or air to escape directly from such pipe to the brake-cylinder, while such cylinder is substantially free from pressure, and before fluid pressure or air has entered said cylinder from the auxiliary reservoir in sufficient quantity to materially interfere with the escape from the pipe to the cylinder. When each car of the train is provided with one of these devices it will be seen that they are successively moved with great rapidity, there being practically, in a train of fifty cars, fifty openings for discharging fluid pressure or air from the main air or train pipe, instead of the single opening heretofore commonly used. Not only is there a passage of considerable size, relatively to that of the opening or passage leading from the auxiliary reservoir to the brake-cylinder, opened from the main air or train pipe on each car, whereby the pressure is more quickly reduced, but the pressure or air so escaping from such pipe to the brake-cylinders is utilized in the performance of applying the brakes, as heretofore explained in connection with the action of quick-action triple valves in general.

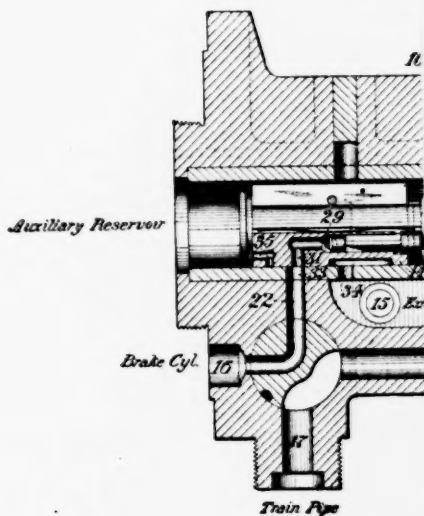
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Quick A



In the preferred or illustrated form, when the piston 12 arrives at the extremity of its backward stroke or movement as above specified, a supplemental port or opening 35 of the slide-valve 14 is brought into communication or register with the port or opening 23 and passages 22 and 16, which serves to discharge or permit the escape of the auxiliary reservoir pressure into the brake-cylinder at or nearly simultaneously with the pressure entering such cylinder directly from the main air or train pipe, thus augmenting the pressure exerted by the direct admission of pressure or air from such pipe. Upon the reduction of the pressure in the main air or train pipe below that in the brake-cylinders, as by the breaking in two of the train or the bursting of a pipe, check-valve 49 closes communication between the passages 46 and 18, thereby preventing the escape of pressure or air from the brake-cylinder to the main air or train pipe, and holding such pressure or air in the cylinder to be utilized in applying the brakes.

The movement or stroke of the piston 12 beyond the point where the two first classes of work, as heretofore explained, are performed, and which two classes of work are performed by what I have termed the first or preliminary movement or traverse of the piston, and which further movement of the piston 12 actuates the auxiliary valve device 41 by the backward movement of the stem 36, I will term the second or further movement or traverse of the piston 12, it being the movement which opens direct communication between the main air or train pipe and the brake-cylinders.

Claim 1 of the said patent in suit reads as follows:

"1. In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake-cylinder, a triple valve and an auxiliary valve device actuated by the piston of the triple valve and independent of the main valve hereof, for admitting air in the application of the brake directly from the main air pipe to the brake cylinder, substantially as set forth."

Said claim 1 when read in light of the specification, as I understand the matter, is composed of five essential elements or devices combined together to form a brake mechanism, which elements or devices are as follows:

a. A main air or train pipe adapted to connect with a source of fluid pressure or air supply and a triple valve.

b. A reservoir adapted to be connected with the source of fluid pressure or air supply through a triple valve, and also adapted to be attached to a car.

c. A brake-cylinder provided with a piston and means for connecting the same with the brake-shoes of the wheels of the car.

d. A triple valve having the capacity of performing the ordinary functions of such a valve, such as performing the two first classes of work heretofore referred to, and adapted to actuate an auxiliary valve device through contact with, or a connection of the piston with some portion of such valve device.

e. An auxiliary valve device adapted to open direct communication between the main air or train pipe and the brake-cylinders,

and which is independent of the valve which performs the main or primary functions in applying and releasing the brakes, and is also adapted to be actuated in one direction by reason of contact, or a connection between the piston of the triple valve and the auxiliary valve device.

The above-named five essential elements or devices when combined, as above indicated and set forth in the specification of the patent in suit, form an automatic quick-action system of brakes for a single car, and contain the essential elements particularly set forth or pointed out in said claim 1.

Claim 2 of this same patent is in the following language :

" 2. In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake-cylinder, and a triple valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake-cylinder, and which by a further traverse admits air directly from the main air pipe to the brake-cylinder, substantially as set forth."

This claim 2, when read in the light of the specification as I understand the matter, is for a combination of four essential elements or devices combined together to form a brake mechanism, and such essential elements or devices are as follows :

38 The first three elements or devices of this second claim are substantially the same as the first three of claim 1, and therefore I will not repeat them.

d. A triple valve provided with a piston and a valve mechanism, the piston having two movements or traverses, one greater in extent than the other, the greater one including the lesser, the first or preliminary movement or traverse of such piston operating the valve mechanism for the admission of fluid pressure or air from the auxiliary reservoir to the brake-cylinder, to perform the functions of an ordinary triple valve in the first two classes of work heretofore referred to, and the second or further movement or traverse of the piston operating the valve mechanism so as to open communication between the main air or train pipe and the brake-cylinder for the direct admission of fluid pressure or air from such pipe to such cylinder to perform the third class of work heretofore referred to.

The above four essential elements or devices when combined as above indicated, and as set forth in the specification, form a brake mechanism for use in the automatic quick-action system of brakes, and contain the essential elements or devices particularly pointed out in said claim 2.

Claim 4 of the patent in suit is as follows :

" 4. The combination in a triple-valve device of a case or chest, a piston fixed upon a stem, and working in a chamber therein, a valve moving with the piston stem, and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere respectively, and an auxiliary valve actuated by the piston stem and controlling communication between passages leading to connections with a main air pipe and with the brake-cylinder respectively, substantially as set forth."

39 Said claim 4, when read in the light of the specification, as I understand the matter, is for the combination of the following four essential elements or devices, in a single casing or chest, to form a quick-action triple valve.

(a.) A casing or chest provided with a chamber adapted to receive a piston and have the same work therein, and provided with ports or passages leading to connections adapted to connect with an auxiliary reservoir, a brake-cylinder and the atmosphere, and also provided with passages leading to connections adapted to connect with a main air or train pipe and a brake-cylinder.

(b.) A piston fixed upon a stem and adapted to work in a chamber in the casing or chest, and also to actuate an auxiliary valve.

(c.) A valve adapted to be moved by the piston and to govern or control the ports and passages in the casing or chest leading to the connections with an auxiliary reservoir, a brake-cylinder and the atmosphere.

(d.) An auxiliary valve adapted to control or govern communication between the passages in the casing or chest leading to the connections with a main air or train pipe and a brake-cylinder.

The above four essential elements or devices when combined as above indicated and set forth in the specification, form a mechanism in a single casing or chest which is capable of performing, when properly connected as stated, the three classes of work heretofore referred to, and the same is known in the art as a quick-action triple valve, and it contains the essential elements or devices particularly pointed out in said claim 4 of the patent in suit.

Int. 5. Have you examined Complainants' Exhibit Defendants' Quick-action Triple Valve, and compared the same with plate XI, and the description thereof in Complainants' Exhibit Defendants' 1891 Catalogue?

40 A. I have carefully compared said defendants' quick-action triple valve with plate XI of said defendants' 1891 catalogue, and find the said valve to substantially correspond with said plate.

Int. 6. Will you please describe briefly and generally the construction and operation of Complainants' Exhibit Defendants' Quick-action Triple Valve, and in making such description refer to Complainants' Exhibit Defendants' 1891 Catalogue where you may find the same pertinent?

A. I will at this point state, as a result of my comparison of the said Exhibit Defendants' Quick-action Triple Valve with plate XI in said defendants' 1891 catalogue that I found the following differences:

1st. In the place of the passage B, shown in said plate, as leading from the chamber C to the piston chamber D, back of the triple-valve piston 29, there was a limited space left between the hollow triple-valve piston stem and bushing 9, which permitted fluid pressure to pass from the chamber C, between such piston stem and bushing 9, into the piston chamber D, and from thence into the auxiliary reservoir through the passage A. This limited space or looseness of the hollow piston stem and the bushing 9, was supplied

mented by two shallow grooves leading from the chamber C, along such piston stem to within about a quarter of an inch of piston 29, so that when the ends of such grooves nearest the piston 29 were moved through and beyond the bushing 9 by the backward movement of the piston 29, such grooves, when thus moved, permitted a greater escape or passage of fluid pressure from such piston chamber D into the chamber C than was possible with the slight space or looseness heretofore referred to between the hollow piston stem and such bushing 9.

The result of this difference in the construction between said defendants' quick-action triple valve and the one shown in said plate XI, is that the auxiliary reservoir will be charged more slowly, when the construction is that of said defendants' quick-action triple valve, than would be the case when the construction was
41 that of said plate XI; but this difference would not otherwise change the operation, and, in my opinion, it would not materially effect the combinations shown in said plate XI.

It will also be observed that the screw-plug, designated as 4 in the chamber E of said plate XI, is missing from said defendants' quick-action triple valve, but the hole for such plug is now present. There is also in said defendant's quick-action triple valve a hole made in the casing or chest opposite the chamber C, which is not found in said plate XI, and which, I understand, would not be present in said quick-action triple valve when put into actual practice.

These last two differences, like the first one mentioned, do not materially affect the questions at issue, because it is manifest that the said screw-plug 4 could be readily supplied, and the hole through the casing or chest be stopped up, and thus place the said quick-action triple valve in condition, when the proper connections are made, to be wholly operative in the manner in which the valve of said plate XI is operative.

For convenience of marking the several operative parts, I will use said plate XI in my description of said Exhibit Defendants' Quick-action Triple Valve.

The said Exhibit Defendants' Quick action Triple Valve is a mechanism having the capacity of performing the three classes of work heretofore referred to by me, viz., "graduating," making "service stops" and also "emergency stops;" and, like all triple valves, is provided with a casing or chest, which has a piston chamber in which a piston works, which piston is provided with a stem and a valve mechanism, by means of which, upon the variation of fluid pressure in the main air or train pipe, the three connections, heretofore referred to, with the threefold function, is adapted to be made and performed.

Said quick-action triple valve is adapted to be connected with the main air or train pipe by the connection designated as 1 on said plate XI, which plate will also bear the designating characters hereafter referred to in my description of the said defendants' quick-
42 action triple valve. The casing or chest of the said defendants' quick-action triple valve is adapted to be connected

with an auxiliary reservoir, by attaching the same thereto, so that the passage A registers with an opening in such reservoir, and the said casing or chest is also adapted to be connected to the brake-cylinder by securing such casing or chest to such cylinder, so that the passages *h h* will register with suitable openings in such cylinder; said casing is also provided with the passage G, leading to the atmosphere.

The manner in which these connections may be made with the said triple valve, auxiliary reservoir, and brake-cylinder will be found in plate X of said Exhibit Defendants' 1891 Catalogue, wherein 1 is the auxiliary reservoir, and 2 the brake-cylinder, and the quick-action triple valve is designated as "quick-action valve," and the point at which the connection is made between the main air or train pipe is designated "to train-pipe."

For the better illustration of these several connections, I produce a drawing with the above-named several parts arranged in substantially the same manner as in the said plate X, but with the quick-action triple valve also in section. This arrangement will be found in Fig. 1 of said drawing, which, it will be observed, is upon a much enlarged scale than that of said plate X.

Fig. 2 of said drawing is a cross-sectional view of the quick-action triple valve shown in Fig. 1, but taken upon another line, so as to show the same connected to the auxiliary reservoir as the same would be shown when such quick-action triple valve is made on the same section line as that on which said plate XI is made upon, and which would be at right angles to that on which said valve is shown in Fig. 1.

Counsel for complainant- offers and puts in evidence the drawing referred to by the witness, and the same is marked "Complainants'

Exhibit Drawing Defendants' Quick-action Triple Valve and
43 Connections, R. H. Whittlesey, special examiner."

The casing or chest of the said quick-action triple valve, as the same is represented in said plate XI, is provided with ports or passages leading from the main air or train pipe to the auxiliary reservoir and then to the brake-cylinder, and from thence to the atmosphere. Said casing or chest is also provided with ports or passages leading from the main air or train pipe directly to the brake-cylinder.

The said casing or chest is provided with a piston chamber designated as D, in which a piston 29 works forward and backward, as the case may be, leaving a space or portion of such chamber on each side of the piston. That portion of the piston chamber D, which is nearest the connection with the main air or train pipe I will call the main air or train pipe portion, and the portion nearest the connection with the auxiliary reservoir I will call the auxiliary reservoir portion.

The piston 29 is provided with a hollow piston stem, in which a check-valve 26 works, so that the opening or passage F through such stem is opened by the unseating of the check-valve 26, whenever the main air or train pipe pressure exceeds that in the chamber

C, openings being made in such hollow piston stem leading into such chamber C. A spring 27 is arranged to hold the check-valve 26 seated when the main air or train pipe pressure is slightly less than that in the chamber C and the added pressure of the spring 27, or when the two pressures are equal.

This hollow piston stem is closed at its inner end or the end nearest the auxiliary reservoir and brake-cylinder, and to this closed end there is attached a valve 17-18, the portion 18 being provided with ports or openings *i, j*, which are connected together by a passage *k*, shown in dotted lines in said plate XI. The portion 17 of this valve 17-18 moves back and forth in a cylindrical or tubular recess designated *l*, which recess has a port or opening leading into the passage G, and when the piston 29 is in the position shown in said plate XI, which is the extreme limit of its forward movement or stroke, this port or opening is open, so that the portion of the recess *l* nearest the piston stem is in communication with the passage G, and when the piston begins its backward movement this port or opening is closed and such communication is shut off.

Adjourned to meet at same place tomorrow, Thursday, July 16, 1891, at 10.30 a. m.

R. H. WHITTLESEY,
Special Examiner.

NEW YORK, *July 16th*, 1891.

Met pursuant to adjournment.

Counsel present as at last meeting.

The witness HENRY F. NEWBURY continues his answer to Int. 6:

It will be observed that this cylindrical or tubular recess *l* opens into the chamber II, which communicates with the brake-cylinder through the passages *h h*, so that the brake cylinder is in open communication with the atmosphere through the passages *h h*, chamber II, recess *l*, the port or opening leading therefrom to the passage G, and thence through such passage to the atmosphere.

The valve 17-18, as it is moved with the piston 29, passes through a valve 22, and moves therein during the greater portion of such backward and forward movement, and, as a result of such movement of the valve 17-18, in and through the valve 22, the port or opening *i* is either moved out from such valve 22, so as to open communication between such port and the chamber C, upon the backward movement of the piston 29, when the port *i* is withdrawn from the valve 22 and placed in communication with the chamber C, or moved into such valve 22, so as to close communication between the port or opening *i* and the chamber C, upon the forward movement or stroke of the piston 29, when the port or opening *i* enters the valve 22 and closes communication with the chamber C. When the port *i* is withdrawn from the valve 22, as just described, the chamber C is in communication with the chamber II, through the port or opening *i*, passage *k* leading there-

from to the port or opening *j*, and from such chamber H to the brake-cylinder through the passages *h h*.

The valve 22 will be held to its seat, as shown in plate XI of said defendants' 1891 catalogue, whenever the pressure in the chamber C exceeds or equals that in the chamber H. It will be observed that the area of surface of valve 22, exposed to the action of fluid pressure, is greater upon the side of the valve adjacent to the chamber C than its opposite side, which is adjacent to the chamber H, and because of this fact said valve 22 will be held to its seat when the pressures are equal on its two sides, owing to the excess of area to be acted on by the fluid pressure on that side adjacent to chamber C.

The piston, 29, as it nears the extreme limit of its backward movement or stroke, lifts the valve, 22, from its seat by reason of the contact of the collar, *m*, attached to the portion, 18, of the valve, 17-18, coming into contact with the side of the valve, 22, adjacent to the chamber, H, before the piston, 29, has reached the extreme limit of its backward movement, and upon the further movement or traverse of the piston, 29, in a backward direction, after the collar, *m*, has come in contact with valve 22, such valve then partakes of the movement of the piston, 29, and its stem, to which the valve, 17-18, is secured.

When the valve, 22, is lifted from its seat upon the piston, 29, reaching the extreme limit of its backward movement, the chamber C is in open communication with the chamber H, through the port or opening made between the valve, 22, and its seat, which port or opening is several times the size of the passage, B, leading from the chamber, C, to the auxiliary reservoir portion of the
46 piston chamber, D, and thence through such portion of chamber, D, and passage, A, to the auxiliary reservoir.

From the above it will be seen that the casing or chest is provided with ports and passages leading from the connection, 1, with the main air or train pipe through the chamber, E, the main air or train pipe portion of the piston chamber, D, passage, F, in the hollow piston stem, past the check-valve, 26, into the chamber, C, thence through the passage, B, into and through the auxiliary reservoir portion of the piston chamber, D, and passage, A, to the auxiliary reservoir.

From the auxiliary reservoir, the passages and ports in the casing or chest of said defendants' quick-action triple valve lead backward through the passage A, auxiliary reservoir portion of the piston chamber D, passage B, into the chamber C, and from thence through the port or opening *i*, passage *k*, and port or opening *j*, in the valve 17-18, through the chamber H and passages *h h* into the brake-cylinder. From the brake-cylinder, the passages and ports in the casing or chest of said defendants' quick-action triple valve lead backward through the passages *h h* into chamber H, and from thence through the cylindrical recess *l* and port or opening leading therefrom into the passage G to the atmosphere. The above-named passages and ports in the casing or chest of said defendants' quick-action triple valve give such valve a connection with the main air or train pipe,

another with an auxiliary reservoir, and another with a brake-cylinder, for the utilization of fluid pressure or air in the application of the brakes, and a release or discharge passage for releasing the operative fluid pressure or air from the brake-cylinder, thus giving said defendants' quick-action triple valve the three connections essential for the operation of a triple valve in performing the two first classes of work heretofore referred to by me, and when such two classes of work are performed the threefold function heretofore named is also performed.

The casing or chest of said defendants' quick-action triple valve is also provided with passages and ports leading from the
47 connection 1 with the main air or train pipe, through the chamber E and the main air or train pipe portion of the piston chamber D, passage F in the hollow stem of piston 29, past the check-valve 26, into the chamber C, through the port or opening between the valve 22 and its seat, into the chamber H, and through the passages *h h* into the brake-cylinder.

These latter passages and ports open communication directly from the main air or train pipe to the brake-cylinder, and main air or train pipe pressure is thereby admitted directly to the brake-cylinder without first passing into the auxiliary reservoir, thus giving said defendants' quick-action triple valve the capacity of performing the third class of work heretofore referred to, wherein the brakes are applied to the wheels of the car in a much quicker or shorter space of time and with greater effective force than when the two first classes of work heretofore referred to are performed.

The valve 17-18 of said defendants' quick-action triple valve is so arranged relatively to the piston 29, that the port or opening leading from the cylindrical or tubular recess *l* to the passage G, upon the beginning of the backward movement of such piston by the portion 17 moving over and past such port or opening and closing or shutting it off from such recess *l*, during the rest of the backward movement of the piston, whatever that may be. This closing or shutting off of this port or opening by the backward movement of the piston 29 and the valve 17-18 is accomplished before the port or opening *i* and the valve 17-18, is moved so as to open into the chamber C, by passing beyond the valve 22 through which it moves; so that recess *l* is shut off from the atmosphere before fluid pressure can enter the port or opening *i*, from the chamber C, and the pressure so entering the chamber H passes into the brake-cylinder and is held there to be utilized in applying the brakes.

The operation of the said Exhibit Defendants' Quick-action Triple Valve is as follows, when the connections are made with the main air or train pipe, auxiliary reservoir and brake-cylinders, as the same is adapted to be connected as I have heretofore stated:

48 Main air or train pipe pressure entering the chamber E exerts its force on the piston 29, forcing it forward to the extreme limit of its movement or stroke in that direction and causing the portion 17 of the valve 17-18, to open the port or opening lead-

ing from the recess *l* to the passage G, thus permitting any fluid pressure in the brake-cylinder to escape to the atmosphere, when such main air or train pipe pressure will lift the check-valve 26 off from its seat and enter the chamber C, pass through the passage B and the auxiliary reservoir portion of the piston chamber D into the auxiliary reservoir through the passage A, until the fluid pressure in the auxiliary reservoir, and the pressure exerted by the spring 27, closes the check-valve 26, by reason of the substantial equalization of the pressures in the main air or train pipe and the auxiliary reservoir.

The forward movement of the piston 29, and the excess of pressure in the chamber C over that in the chamber H, causes the valve 22 to be seated, if, for any reason it had not become so, upon the forward movement of the piston; and the port or opening *i*, in the valve 17-18, is moved into valve 22, so that communication between chambers C and H, either through the valve 17-18 or the valve 22, is thereby closed.

In this condition the said "defendants' quick-action triple valve" would be in what is known as "running order," that is, ready to apply or release the brakes and perform any one of the three classes of work heretofore referred to as occasion might require.

To apply the brakes and perform either one of the two first classes of work heretofore referred to, the engineer would allow fluid pressure to escape from the main air or train pipe, by means of his operating valve or cock to the extent desired, and thus reduce the pressure in such pipe below that in the auxiliary reservoir, when the greater pressure on the auxiliary reservoir side of the piston would force such piston backward, causing the portion 17 of the valve 17-18 to close communication between the brake-cylinder and the atmosphere, and such backward movement of the piston 29 would be sufficient to cause the port or opening *i* in the valve 17-18 to move out of the valve 22, and open communication between the chambers C and H, for the admission of fluid pressure from the auxiliary reservoir to the brake-cylinder through the passage A, to the auxiliary reservoir portion of the piston chamber D, thence through the passage B, chamber C, port or opening *i*, passage *k*, port or opening *j*, into the chamber H, and thence through the passages *h h* into the brake-cylinders, and the admission of fluid pressure from the auxiliary reservoir in the brake-cylinder will continue until the auxiliary reservoir pressure is slightly less than that of the main air or train pipe, when the preponderance of pressure upon the main air or train pipe side of the piston 29 will cause it to move forward a distance sufficient to cause the port *i* of valve 17-18 to enter the valve 22, and shut off communication between the auxiliary reservoir and brake-cylinder, but not a distance sufficient to open the brake-cylinder to the atmosphere.

The amount of fluid pressure allowed to enter the brake-cylinder in performing these two classes of work, as before explained, is determined by the amount of pressure allowed to escape slowly at one

time from the main air or train pipe at the engine by means of the engineer's cock or valve.

To release the brakes, fluid pressure is allowed to enter the main air or train pipe from the main reservoir upon the engine by means of the engineer's cock or valve, thus increasing the main air or train pipe pressure above the auxiliary reservoir pressure, when the preponderance of pressure upon the main air or train pipe side of the piston 29 causes such piston to move forward to the extreme limit of its movement in that direction, opening the brake-cylinder to the atmosphere by the movement of the portion 17 of the valve 17-18 in the recess *l*, far enough to open the port or opening leading from such recess to the passage G and permitting the pressure in the brake-cylinder to escape to the atmosphere and move the brake-cylinder piston backward and through the connections of such pistons with the brake-shoes, relieving the wheels of the cars from the presence of such shoes, thus releasing the brakes and at the same time opening the check-valve 26 and recharging the auxiliary reservoir with pressure equal to that in the main air or train pipe.

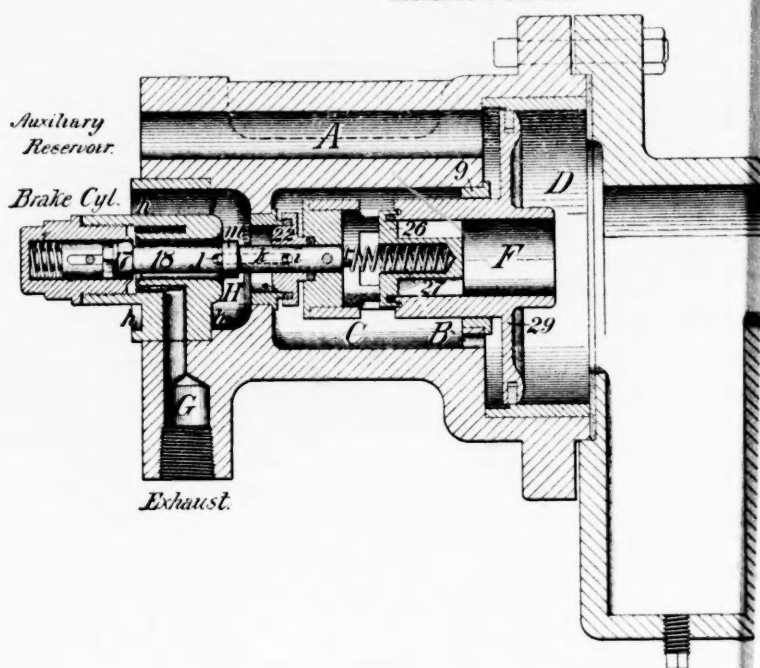
The said defendants' quick-action triple valve has the capacity of performing the second class of work namely, making "service stops," by making a series of "graduating" applications, that is, allowing fluid pressure to escape from the main air or train pipe, a little at a time instead of continuously, until the fluid pressure admitted to the brake-cylinders from the auxiliary reservoirs is sufficient to apply the brakes to the extent necessary to stop the train. The difference between making a "service stop" by a series of "graduating" applications, instead of by a continuous and slow escape of pressure from the main air or train pipe, is that the brake-cylinder receives a series of augmenting admissions of fluid pressure from the auxiliary reservoir, instead of a continuous admission, and that, in making a stop by a series of "graduating" applications, that such stop is made more slowly, owing to the fact of time elapsing between each two of a series of "graduating" applications.

From the above it will be seen that the valve 17-18 performs the ordinary functions of a "triple valve" as heretofore explained; that is, it performs the main or primary functions in applying and releasing the brakes, and because of this fact, it may be correctly and fitly termed the main valve of the said Exhibit Defendants' Quick-action Triple Valve, and I will so term it.

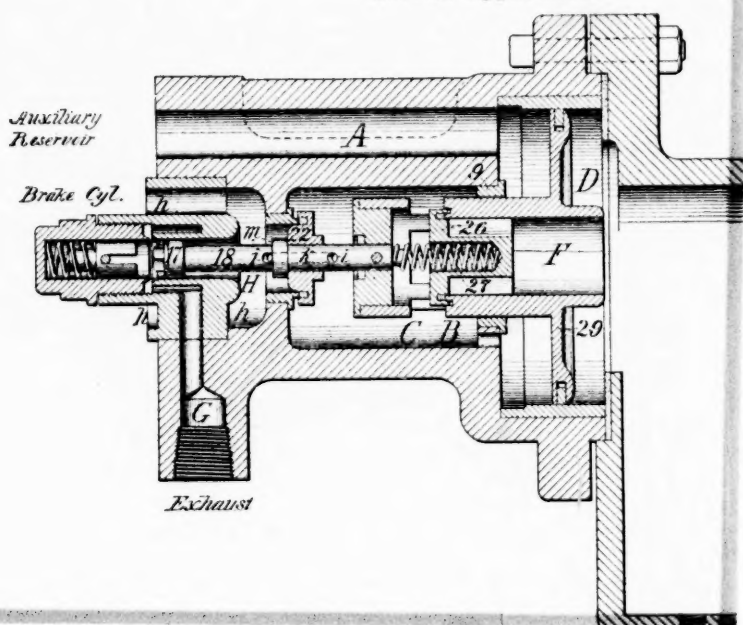
(Here follow diagrams marked pp. 50a & 50b.)

To apply the brakes in the quickest or shortest possible time and with greater force than when a service stop is made, as heretofore described with said defendants' quick-action triple valve, the engineer allows a considerable amount of fluid pressure, equal to, or somewhat less than, the amount allowed to escape when making a "service stop," to quickly escape from the main air or train pipe, which results in the almost instantaneous backward movement of the piston 29 to the extreme limit of its movement

Release Position.



Service Application.



or stroke in that direction, causing the collar *m* on the portion 18 of the valve 17-18 to contact with the valve 22 and remove it from its seat, the portion 17 of the valve 17-18 meanwhile closing communication between the brake-cylinder and the atmosphere. As a result of unseating the valve 22 as just described, fluid pressure in the chamber C immediately escapes or expands into the brake-cylinder, and owing to the fact that the port or opening between the valve 22 and its seat being of much greater size or capacity than the passage B leading from said chamber C to the auxiliary reservoir, the fluid pressure in the chamber C escapes or expands into the brake-cylinder much faster than it can enter such chamber from the auxiliary reservoir, and as the escape from the chamber C takes place when the brake-cylinder is substantially free from such pressure, it results that pressure in the chamber C is reduced far below that in either the auxiliary reservoir or the main air or train pipe. Owing to the fact that the pressure in the chamber C is reduced far below that in the main air or train pipe, the check-valve 26 is immediately moved from its seat by the greater force exerted by the main air or train pipe pressure, opening communication between the main air or train pipe and brake-cylinder for the direct admission of fluid pressure or air from such pipe to the brake-cylinder, and such admission will continue until the combined pressures entering the brake-cylinder from the auxiliary reservoir simultaneously with that from the main air or train pipe is slightly less than the reduced pressure in such main air or train pipe, when the check-valve 26 will become seated owing to the action of the combined pressures being the same in the chamber C that they are in the brake-cylinder by reason of large port or opening made between the valve 22 and its seat when such valve is unseated as before described. Upon the closure of the check-valve 26, the escape or expansion of main air or train pipe pressure ceases and the further reduction of such pressure also ceases. This direct admission of fluid pressure from the main air or train pipe to the brake-cylinder necessarily reduces the pressure largely in such pipe adjacent to the quick-action triple valve through which the expansion took place, and as a result of such reduction of the pressure in the main air or train pipe at this point, the next quick-action triple valve will be caused to operate in like manner and cause a still further reduction of pressure in such pipe adjacent to such next quick-action triple valve, which in turn would, in like manner, cause the next adjacent quick-action triple valve to repeat this operation, and so on throughout the train, each car of which is supplied with quick-action triple valves like that of said Exhibit Defendants' Quick-action Triple Valve, and thus the pressure in the main air or train pipe throughout the length of the train is reduced without such air traveling from the rear of the train to the engine, there being as many openings for the escape of fluid pressure or air as there are quick-action triple valves connected with the main air or train pipe. The escape of fluid pressure directly from the main air or train pipe to the brake-cylinders is therein utilized in applying the brakes. Upon the closing of the check-valve 26, fluid

pressure from the auxiliary reservoir continues to expand into the brake-cylinder, either through the port or opening between the valve 22 and its seat, or through the port or opening *i*, passage *k*, and port or opening *j* of the valve 17-18, or both of such ports or openings, until the pressure in each of the brake-cylinders equals that in its corresponding reservoir, or, in other words, until an equilibrium is established between the pressure in each brake-cylinder and its corresponding reservoir throughout the train.

From this description of the operation of defendants' quick-action triple valve it is manifest that the portion 18 of the valve 17-18 first opens communication between the chamber C and the brake-cylinder, and that such communication remains open until the pressure on the main air or train pipe side of the piston 29 is sufficiently greater than that upon the auxiliary reservoir side to force 53 the piston 29 forward a distance far enough to cause the port *i* to again enter the valve 22, and that the valve 22 is seated before such port or opening enters it.

The operation of said defendants' quick-action triple valve also makes it manifest that the valve 22 is supplemental or auxiliary to the main valve 17-18, and that such is the case no matter what one of the three classes of work heretofore referred to is performed.

This valve 22 is styled or termed a "main valve" in the description found in said Exhibit Defendants' 1891 Catalogue relating to the quick-action triple valve illustrated in plate XI of that catalogue, and in the description of the operation of said defendants' quick-action triple valve, it is stated as follows:

"TO APPLY THE BRAKES FULLY (*not a quick action*) an amount of air is allowed to escape gradually from the train-pipe that will move the piston 29 to unseat the main valve 22, and allow air to pass from the auxiliary reservoir through the same ports as when graduating, and in addition through that one opened by the main valve 22."

From this it would appear that in order "to apply the brakes fully (*not a quick action*)," which I understand to be making a "service" or other ordinary stop or, in other words, performing the second class of work to which I have heretofore referred, that it was necessary to unseat the valve 22, but I think it is manifest from what I have heretofore said, that such is not the fact, and in support of my view of this matter I find that it is stated on page 37 of said Exhibit Defendants' 1891 Catalogue that

"A service stop should be made with not more than two 'graduating' applications.

"The force with which the brakes will be applied in a service stop will be determined by the number of times the handle is placed in position 4, or the length of time it is allowed to remain there."

54 From a reading of all the matter relating to the operation of said defendants' quick-action triple valve found in said defendants' 1891 catalogue, I understand that the handle referred to in the above quotation is the handle of the engineer's operating valve or cock heretofore referred to, and which is styled on page 37

of defendants' 1891 catalogue "the engineer's brake-valve," and that the "position 4," referred to in the said quotation, is the position in which the handle of the engineer's operating cock or valve is placed when making a "graduating" application, and also the position in which the same handle is placed when making a "service stop."

From the above quotation I also understand that a "service stop" can be made in two ways: first, by a series of "graduating" applications, wherein the handle of the engineer's operating cock or valve is placed in "position 4," and allowed to stay there but a short time at each one of the series of applications used in making the "service stop;" and, second, by placing the handle of the engineer's operating valve or cock in the "position 4," and allowing it to remain there until the pressure in the main air or train pipe is reduced sufficiently to allow a sufficient amount of fluid pressure from the auxiliary reservoir to escape or expand into the brake-cylinders and stop the train. The "position 4," in which the handle of the engineer's operating cock or valve is placed, is a position where I understand fluid pressure is allowed to escape slowly or gradually, as distinguished from a position where it can escape suddenly, or the greatest amount in the shortest possible time is allowed to escape.

It is true that under certain conditions, which I will shortly describe, the valve 22 may be unseated and yet not have a direct admission of fluid pressure or air from the main air or train pipe to the brake-cylinder, or an admission which will cause quick action to take place, but whenever this takes place the action of such valve

22 is supplemental or auxiliary to that of the main valve 17-18, and it at no time can be correctly said to perform the main or primary functions in applying and releasing the brakes, and whatever its action may be, it is always auxiliary to the main valve 17-18.

The conditions to which I referred in the preceding paragraph, and under which the unseating of the auxiliary valve 22 might take place without the direct admission of fluid pressure or air from the main air or train pipe to the brake-cylinder taking place, or, if taking place, a quick action is not produced, are as follows: When the engineer allows fluid pressure to escape from the main air or train pipe at the engine slowly, so that the piston 29 is caused to move backward by preponderance of auxiliary reservoir pressure as heretofore explained, sufficiently to bring the port or opening *i* of the main valve 17-18 in communication with the chamber C, and when this is done auxiliary reservoir pressure cannot escape into the brake-cylinder faster than it can enter such chamber through the passage B, and as a result the pressure in the chamber C remains substantially that of the auxiliary reservoir, which is necessarily greater than that of the main air or train pipe, and therefore the check-valve 26 cannot be unseated because the main air or train pipe pressure is less than that in the chamber C, and when sufficient auxiliary pressure has entered the brake-cylinder to exert a pressure approaching that in the cylinders when a service stop is

made, then the engineer may allow any amount of pressure he chooses down to the entire amount in the main air or train pipe to escape therefrom and move the piston 29 to the extreme limit of its backward movement and unseat the valve 22 to its greatest extent, and the check-valve 26 will remain closed, because the pressure already in the brake-cylinder and chamber C would exceed the reduced pressure in the main air or train pipe and prevent the check-valve 26 from becoming unseated, and consequently the direct admission of main air or train pipe pressure past such valve into the brake-cylinder is prevented.

As before explained the fundamental or underlying principle of what has become known as a quick-action system of brakes requires that the brake-cylinder should be comparatively free from pressure at or near the commencement of the admission of fluid pressure from the main air or train pipe to the brake-cylinders, and, under the conditions just named above, this fundamental or underlying principle is not present, and it is an impossibility under such a condition to have quick action take place.

Adjourned to meet at same place tomorrow, Friday, July 17th, 1891, at 10.30 o'clock a m.

R. H. WHITTLESEY,
Special Examiner.

JULY 17, 1891.

Met pursuant to adjournment.

Present: Counsel as at last meeting.

The witness, HENRY F. NEWBURY, continues his answer to Int. 6:

(A. 6 continued.) Another condition under which the auxiliary valve 22 may be unseated and yet not have a direct admission of air or fluid pressure from the main air or train pipe to the brake-cylinder, is when the port or opening made by the unseating of such auxiliary valve and that of the port or opening *i*, combined together, are equal in capacity to the passage B, leading from the chamber C with the auxiliary reservoir portion of the piston chamber D, or when the capacity of such combined ports or openings does not exceed that of the passage B to an extent sufficient to reduce the pressure in the chamber C below that in the main air or train pipe, so that the spring 27 and the increased area of the check-valve 26 on its side adjacent to the chamber C will not permit such check-valve to be unseated by the main air or train pipe pressure acting upon the smaller area of such valve. Under this condition there is no direct admission of pressure or air whatever from the main air or train pipe to the brake-cylinder, no matter whether there is any substantial pressure in the brake-cylinder or not from the beginning to the ending of the unseating of the auxiliary valve 22; and the only action of such valve is supplemental or auxiliary to that of the main valve 17-18, which performs the main or primary functions in applying and releasing the brakes.

Another condition under which, even though there be a direct admission of main air or train pipe pressure to the brake-cylinder, there can be no quick action or any substantial reduction of pressure in the main air or train pipe, is when the brake-cylinder has received pressure from the auxiliary reservoir to an extent sufficient to exert a pressure in both the cylinder and the chamber C, slightly less than will prevent the spring 27, and the greater area of the check-valve 26 on its side adjacent to the chamber C, from equalling the main air or train pipe pressure upon the opposite side of the check-valve, and by reason of the slightly greater force on the main air or train pipe side of the check-valve, such check-valve will open slightly and permit a slight escape of fluid pressure or air from the main air or train pipe adjacent to the check-valve, but not enough to in any way affect the next following quick-action triple valve, or to materially hasten or quicken the quick-action triple valve through which such slight escape takes place. Therefore, no quick action is possible, and the fundamental or underlying principle of such quick-action triple valves is not present, and any unseating of the auxiliary valve 22, even though it produces an admission of pressure directly from the main air or train pipe to the brake-cylinder as above described, is an action supplemental or auxiliary to the action of the main valve 17-18.

While it is, in my opinion, possible to so manipulate a single or even two or three quick-action triple valves, attached to as many cars, so that a slight direct admission of main air or train pipe pressure to the brake-cylinder upon the first car can take place as just before described, yet I do not understand that this is the manner in which said Exhibit Defendants' Quick-action Triple Valve is intended to be manipulated or worked; for it is manifest that no useful function would be served, and for this reason alone I would be of the above understanding; but as a further reason of such understanding I will refer to the following statements found in said Exhibit Defendants' 1891 Catalogue, upon page 29:

"As the graduating valve" (main valve 17-18) "operates without moving the main valve," (auxiliary valve 22). "it produces a uniform action on the several cars of a train, thereby avoiding jerking and lurching in stopping the same.

"The actions of this valve in graduating, full service application, quick action, and the release, are the same as the new Westinghouse quick-action valve, thereby producing the same results in braking, which renders cars equipped with the two valves perfectly interchangeable, the hose coupling being the same."

The above quotation from said defendants' 1891 catalogue appears to settle beyond a doubt the manner in which "quick-action triple valves" like that of said defendants' quick-action triple valve are intended to work—that is, like "the new Westinghouse quick-action valve," which latter valve does not in practice, as I understand the matter, ever operate, or is intended to operate so that any direct admission of main air or train pipe pressure takes place into the brake-cylinder, although I believe it is possible to so manipulate it,

on a train of one or two cars, that an admission like that heretofore described as taking place under one of the conditions of use of said defendants' quick-action triple valve will take place, yet if such should be the case there could be no quick action, and for

59 the reasons named when stating the condition of use above referred to of said defendants' quick-action triple valve.

The auxiliary valve 22 is independent of the main valve 17-18 because the latter can be moved or operated to perform the main or primary functions in applying or releasing the brakes without moving or operating the auxiliary valve 22.

The main valve 17-18 controls or governs passages and ports in the casing or chest of said defendants' quick-action triple valve leading to connections with an auxiliary reservoir, a brake-cylinder and to the atmosphere respectively, as heretofore explained.

The auxiliary valve 22 controls or governs passages and ports leading to connections with a main air or train pipe and with the brake-cylinder respectively, and is actuated by the piston stem of the triple valve.

For convenience of tracing the above-named ports and passages and showing the direction of fluid pressure as it passes from the main air or train pipe to the auxiliary reservoir, brake-cylinder, and atmosphere, in the operation of said Exhibit Defendants' Quick-action Triple Valve, I will place upon said plate XI two series of arrows, one in full lines indicating the passages and ports and the direction which fluid pressure takes in passing from the main air or train pipe to the auxiliary reservoir, thence to the brake-cylinder, and from the brake-cylinder to the atmosphere; and the other or second series, in broken lines, indicating the passages and ports and direction which fluid pressure takes in passing from the main air or train pipe directly to the brake-cylinder.

I will also place upon Complainants' Exhibit Drawing Complainants' Quick-action Triple Valve and Connections and Complainants' Exhibit Drawing Defendants' Quick-action Triple Valve and Connections, the same letters, numerals and series of arrows which I have placed upon plate XI of said defendants' 1891 catalogue, or used in giving a description of the construction and operation of said Exhibit Defendants' Quick-action Triple Valve.

60 The piston 29 of the said Exhibit Defendants' Quick-action Triple Valve has two movements or traverses—the

first or preliminary movement or traverse operating the valve mechanism of said exhibit so as to admit fluid pressure or air from the main air or train pipe to the auxiliary reservoir, and then to admit pressure from the auxiliary reservoir to the brake-cylinder, to become operative in applying the brakes, and then to permit the escape or exhaust of such operative pressure, after its work is done, to release the brakes and thus perform the main or primary functions in applying and releasing the brakes.

The second or further movement or traverse of the piston 29, operates the valve mechanism of said "Exhibit Defendants' Quick-action Triple Valve," so as to open communication between the

main air or train pipe and the brake-cylinder, for the direct admission of fluid pressure or air from such pipe to the cylinder.

This second or further movement or traverse of the piston 29 of said "Exhibit Defendants' Quick-action Triple Valve," is greater in extent than that of the first or preliminary one, and the greater one includes the lesser.

The main valve 17-18 and auxiliary valve 22 of said Exhibit "Defendants' Quick-action Triple Valve," together form a valve mechanism actuated or controlled by the piston of the triple valve, and by means of which the two movements or traverses perform the three classes of work heretofore referred to by me.

The casing or chest, with its piston chamber D, piston 29, the main valve 17-18, and the passages and ports in such casing or chest, indicated by the series of arrows in full lines, form a "triple valve," having the three connections and threefold function heretofore referred to, by means of which the first two classes of work heretofore referred to are performed, as in the case of ordinary "triple valves."

Counsel for complainants offers and puts in evidence a catalogue entitled "Temporary Catalogue of Boyden Power Brake Company, Baltimore, Md., U. S. A., Automatic Quick-action 61 Brake System, 1889," and the same is marked "Complainants' Exhibit Defendants' 1889 Catalogue."

Defendants' counsel states that, through inadvertence, a slight error of fact has occurred in the stipulation entered at the beginning of this record, which counsel now desires to correct as follows: It is not true that prior to the time of the filing of the bill in this cause, the defendant corporation had made, used or sold quick-action triple valves, of which "Complainants' Exhibit Defendants' Quick-action Triple Valve" is a specimen, and which are shown and described in plate XI of Complainants' Exhibit Defendants' 1891 Catalogue and the descriptive matter relating thereto. On the contrary, the devices that were made, sold and used by the defendant corporation prior to the filing of the bill in this cause were the devices that are shown and described in Complainants' Exhibit Defendants' 1889 Catalogue, and more particularly illustrated in plate IX on page 22, and described on pages 23, 24 of said last-mentioned exhibit, said triple valves being used in connection with a main air or train pipe, auxiliary reservoirs and brake-cylinders, with the ordinary operative connections, substantially as indicated in the Exhibit Drawing Defendants' Quick-action Brake-valve and Connections. And it is only since the filing of the bill in this cause that the defendant corporation has made, used and sold the form of quick-action triple valve referred to in the stipulation made at the commencement of taking this testimony.

This correction is made, not for the purpose of raising any question as to the substantial similarity of the two forms of quick-action triple valve referred to in this statement of counsel, but for the purpose of putting the facts precisely as they existed. The error was overlooked until the production by the complainants of

62 their Exhibit Defendants' 1889 Catalogue called the defendants' attention to it.

To cure the technical defect in complainants' proofs, render the complainants' evidence pertinent to the issues, and give the court jurisdiction of the case, so that no detriment may result to complainants from the unintentional error hereinabove referred to, defendants' counsel consents that the court may consider the case in all respects as if it had been true in fact that, prior to the filing of the bill in this cause, the defendant corporation had actually made, sold and used one or more of the quick-action triple valves referred to in the opening stipulation; and to that end, and for all purposes of this cause, defendants' counsel, as a matter of form, admits that prior to the filing of this bill the defendant corporation made, sold and used two of said quick-action triple valves, and that said two valves were used in such a way as to give full effect to the principles of action intended to be brought into operation by means of them, that is to say, in connection with a main air or train pipe, auxiliary reservoirs and brake-cylinders, with the ordinary operative connections, substantially as indicated in the Exhibit Drawing Defendants' Quick-action Triple Valve and Connections.

It is stipulated that said Exhibit Defendants' 1889 Catalogue is a catalogue issued and circulated by the defendant corporation subsequent to the date of the patents sued on, and prior to the filing of the bill in this cause.

(Here follows diagram marked p. 62a.)

Int. 7. Please examine plate IX and the accompanying description in defendants' 1889 catalogue, and state in what manner and to what extent the construction and operation of the "quick-action brake-valve" therein set forth accord with or differ from those of the quick-action triple valve of defendants' 1891 catalogue as described by you in your answer to Int. 6.

63 A. I have carefully examined said plate IX of said defendants' 1889 catalogue, and the descriptive matter relating thereto, and I find that the "quick-action brake-valve" shown in such plate IX, and described in the said descriptive matter, is in all essential respects substantially the same as the "quick-action triple valve" shown in plate XI, and described in the descriptive matter relating thereto in said defendants' 1891 catalogue.

There is some difference in the form and arrangement of the passages in the casing or chest of the "quick-action brake-valve" of said defendants' 1889 catalogue and the "quick-action triple valve" of plate XI of said defendants' 1891 catalogue.

For convenience in the comparison called for by the question, I will term the quick-action brake-valve of said defendants' 1889 catalogue, defendants' 1889 quick-action brake-valve, and the quick-action triple valve of said defendants' 1891 catalogue, defendants' 1891 quick-action triple valve.

There is a difference in the form and construction of the main valve 17, 18 and the auxiliary valve 22 of said defendants' 1891

"quick-action triple valve" and the corresponding main and auxiliary valves of said defendants' 1889 "quick-action brake-valve," that is, in the former the main valve 17-18 is of the sliding type, and the auxiliary valve 22 is of the poppet type, while in the latter the corresponding main valve 14-29 is of the poppet type, and the corresponding auxiliary valve 41 is of the sliding type. These differences in the type of the two valves of said defendants' 1891 "quick-action triple valve" and said defendants' 1889 "quick-action brake-valve," necessitate some changes in the construction of the valves and the arrangement of the passages in the casing or chest, but the operation of said 1891 "quick-action triple valve," and said 1889 "quick-action brake-valve" are substantially the same, and they perform substantially the same work, with substantially the same means, and in substantially the same way. Therefore
64 they are in substantial accord with one another, and do not materially differ, for the purposes of the present comparison.

One difference in the construction of the main valve *valve* 17-18 of said defendants' 1891 "quick-action triple valve," and the corresponding main valve of the said defendants' 1889 "quick-action brake-valve," rendered necessary by the difference in type of those two valves heretofore referred to, is that said main valve of the latter is divided into two parts so that they can be separated from each other under certain conditions during a portion of their operation; but, as before stated, this difference is not a material one.

For convenience of tracing the passages and ports and the direction which fluid pressure takes in passing from the main air or train pipe to the auxiliary reservoir, and thence to the brake-cylinder, where it is operative in applying the brakes, and from which it escapes or exhausts to the atmosphere to release the brakes and the passages and ports and the direction of fluid pressure from the main air or train pipe directly to the brake-cylinder, I will place upon plate IX of said Exhibit Defendants' 1889 Catalogue the same letters, characters, and series of arrows which I used or placed upon plate XI of said Exhibit Defendants' 1891 Catalogue.

I will hereafter produce a drawing on an enlarged *scal*, similar to the one marked "Complainants' Exhibit Drawing Defendants' Quick-action Triple Valve and Connections" except that the form and construction of the said defendants' 1889 "quick-action brake-valve" will be substituted in place of said defendants' 1891 "quick-action triple valve," in order to show the connection of said defendants' 1889 "quick-action brake-valve" with the main air or train pipe, auxiliary reservoir, brake-cylinder and atmosphere. And I will place thereon corresponding designating letters, numerals and series of arrows found on said "Complainants' Exhibit Drawing Defendants' Quick action Triple Valve and Connections."

Int. 8. Will you please compare "Complainants' Exhibit
65 Defendants' Quick-action Triple Valve" with the mechanism or devices described and shown in "Complainants' Exhibit Patent 360,070," and particularly pointed out in claims 1, 2 and 4 thereof, and state the resemblances and differences, which you find

but I did not deem this difference a material one when considering the substantial identity between the two auxiliary valve devices. For, as I understand the matter, the prime object of the auxiliary valve in each case is that it shall control or govern passages and ports leading from the main air or train pipe to the brake-cylinder, so that such auxiliary valve device can open communication for the direct admission of fluid pressure or air from the main air or train pipe to the brake-cylinder, and thereby cause a reduction in the pressure in such pipe at a point adjacent to such triple valve, so as to affect the following or next adjacent triple valve, and thereby cause a still further reduction of the pressure in such main air or train pipe to quicken the operation of such following or next adjacent triple valve, and so on throughout the length of the train supplied with such quick-action triple valves. And also that the fluid pressure or air escaping from such main air or train pipe at the several quick-action triple valves is utilized in the brake-cylinders to apply the brakes with greater force than is done when no direct admission of fluid pressure or air takes place from the main air or train pipe to the brake-cylinders; and, in the case of defendant's quick-action triple valve, the above-named prime object is served in substantially the same way and by substantially

69 the same means as it is served in the preferred or illustrated form of the patent No. 360,070 in suit.

I also took into consideration the fact that the check-valve 26 of said defendant's quick-action triple valve performs the function that is performed by the feeding groove or opening 51 of the preferred or illustrated form of said patent No. 360,070 in suit, as well as the function performed by the check-valve 49 of such preferred or illustrated form of said patent in suit; but I did not deem this difference a material one, because, as I understand the matter, it was old in the art to have a check-valve, opened by main air or train pipe pressure and closed by auxiliary reservoir pressure to serve the purpose of the feeding groove or opening 51 in the piston chamber 11, and that such a check-valve was one of the means employed for charging the auxiliary reservoir with fluid pressure from the main air or train pipe, prior to the date of the patent No. 360,070 in suit, and comes within the statement heretofore quoted, relating to what is meant by the terms "triple valve" and "triple-valve device."

The function of a check-valve, which permits main air or train pipe pressure upon one side of it to open it when such pressure exerts a force greater than that exerted on its other or opposite side, and is closed when such main air or train pipe pressure exerts a less force than is exerted upon its other side, is the same, and its mode of operation is the same, when used for admitting main air or train pipe pressure to the auxiliary reservoir, or admitting such pressure directly to the brake-cylinder.

Furthermore, I do not understand that the combination of devices particularly pointed out in claim 1 of the patent in suit necessarily requires that there shall be any part or device which shall serve the function of the check-valve 49 in the preferred or illustrated form in which such check-valve forms a part, and therefore the only re-

quirement, as I understand it, of the combination of devices particularly pointed out in said claim 1 is that the "triple valve" of that claim shall have some kind of device by means of which main air or train pipe pressure is permitted to enter the auxiliary reservoir or pass by or through the piston of such triple valve. And because of all the above facts and understandings I am clearly of the opinion that the fact that the check-valve 26 in said "defendants' quick-action triple valve" serves a twofold function as above stated, is a wholly immaterial one, when considering the substantial identity between the combination of devices particularly pointed out in the said claim 1 of the patent No. 360,070 in suit, and said "defendants' quick-action triple valve."

I also took into consideration the fact that the piston of the triple valve of the said "defendants' quick-action triple valve" is arranged relatively to the auxiliary valve 22 of that device, so that a portion of the main valve 17-18 moves in such auxiliary valve, while such is not the case in the preferred or illustrated form of the patent No. 360,070 in suit. But I did not deem this difference a material one, when considering the substantial identity between the combination of devices particularly pointed out in claim 1 of the said patent in suit and the said "defendants' quick-action triple valve," for in each case the arrangement of piston, main valve, and auxiliary valve is such that the auxiliary valve is actuated by the piston, and is independent of the main valve in performing the main or primary functions of applying and releasing the brakes, and also that when such auxiliary valve is actuated by the piston it has the capacity for admitting main air or train pipe pressure directly to the brake-cylinder in the application of the brakes in quicker or shorter time and with greater force than in making "service" stops, and this is, as I understand the matter, the essential thing, and the special form or arrangement of the parts is wholly immaterial. And because of this I am clearly of the opinion heretofore stated regarding the present difference.

Adjourned until Saturday, July 18, at 10.30 a. m.

JULY 18, 1891.

Met pursuant to adjournment.

Present: Counsel as before.

The witness, HENRY F. NEWBURY, continues his answer to Int. 8.

(Answer continued.) As to the materiality of the differences pointed out between said defendants' quick-action triple valve and the preferred or illustrated form of the combination of devices particularly pointed out in claim 1 of said patent 360,070, I took into consideration the following facts, in addition to those heretofore stated, viz:

That the patentee Westinghouse was, so far as I can learn from the prior state of the art, referred to in the answer herein or elsewhere, the first to devise an automatic system of fluid-pressure brakes, in which the action of one triple valve in any way affected

or quickened the action of another triple valve of the system in which the first one was placed ; also that he was the first to devise a system of fluid-pressure brakes in which the action of one triple valve reduced the pressure in a main air or train pipe, and thereby aided in the operation of the next or following triple valve ; also, that he was the first to devise a system in which main air or train pipe pressure—

Defendants' counsel, observing that witness is reading his answer this morning from written memoranda or notes, objects thereto. Counsel did not object to his reading from notes during the early part of the session this week when he was explaining the construction and operation of complainants' device and patent, but thinks it not proper to pursue the practice when testifying as to the defendants' structure and the question of infringement.

Counsel for the complainant submits to the court that there is no impropriety in the witness using notes or memoranda which
72 he is prepared to submit, if necessary, in order to expedite the taking of a lengthy deposition. Maintaining the right of the witness so to do, counsel suggests that, to avoid any question in the matter, the witness hereafter abstain from using his notes, devoting whatever additional time may be rendered necessary by such course.

The witness states that he will recommence his answer at the point at which he had begun to use his notes.

Answer so continued.

As to the materiality of the differences between said defendants' quick-action triple valve and the preferred or illustrated form of the combination of devices particularly pointed out in said claim 1, just referred to in connection with the comparison between said defendants' quick-action triple valve and said combination of devices, I took into consideration the following facts, viz:

That the patentee Westinghouse, so far as I can learn from the prior state of the art referred to in the answer in this cause or elsewhere, was the first to devise an automatic system of brakes in which the action of one triple valve in any way affected or quickened the operation of the next triple valve in the system.

Also that he was the first to devise an automatic system of brakes in which the action of one triple valve reduced the fluid pressure or air in the main air or train pipe, and thereby aided in the operation of the next or following triple valve placed in the system.

Also that he was the first to devise an automatic system in which there were means provided for a direct admission of main air or train pipe pressure to the brake-cylinder, when such cylinder was substantially free from pressure, as upon the beginning of the application of the brakes to the wheels of the cars.

Also that he was the first to devise an automatic system in which
73 there was an auxiliary valve or valve device, which was actuated by the piston of the triple valve, by means of which main air or train pipe pressure was admitted directly to the brake-cylinder, to be utilized therein, and which direct admission

of fluid pressure from such main air or train pipe reduced the pressure in such pipe, and by reason of such reduction affected and quickened the action of the next or following triple valve.

Also that he was the first to devise an automatic system in which fluid pressure or air in the main air or train pipe of lower pressure or force than that in the auxiliary reservoir was admitted to the brake-cylinder from such pipe to be utilized in such cylinder, and be supplemented or added to by the higher pressure or air in the auxiliary reservoir to apply the brakes with an increased force to the wheels of the train.

Also that he was the first to devise an automatic system in which there was a "triple valve" and a valve mechanism which had two movements or traverses; the first or preliminary movement or traverse of such piston and valve mechanism admitted pressure or air from the auxiliary reservoir alone to the brake-cylinder, and the second or further movement or traverse of which admitted fluid pressure or air from the main air or train pipe directly to the brake-cylinder, as well as from the auxiliary reservoir.

The above facts, I think, make it entirely manifest that the said patentee, George Westinghouse, Jr., was the first to devise an automatic quick-action system of brakes, and that in view of the above facts any minor arrangements of parts or change in the form which they make take, such as the differences named in the above comparison between said defendants' quick-action triple valve and the combination of devices particularly pointed out in said claim 1, which does not affect or change the substantial operation of the structures as a whole, is wholly immaterial when considering such substantial identity.

Because of all the facts heretofore stated I am clearly of the opinion that the said "defendants' quick-action triple valve,"
 74 when the same is connected to a main air or train pipe, auxiliary reservoir and brake-cylinder, as shown in said "Exhibit Drawing of Defendants' Quick-action Triple Valve and Connections," resembles the combination of devices particularly pointed out in claim 1 of the said patent 360,070 in all essential particulars, and that any differences which may exist in the form or arrangement of the several parts of the two are wholly immaterial.

I have also made the comparison called for by the question, between the said "defendants' quick-action triple valve" when the same is connected to a main air or train pipe, auxiliary reservoir, and brake-cylinder as shown in said "Exhibit Drawing of Defendants' Quick-action Triple Valve and Connections," and the combination of devices particularly pointed out in claim 2 of said patent 360,070, and find that they resemble each other in having the following four essential elements or devices, combined together to form a brake mechanism for use in what is known as the "automatic quick-action" system of brakes:

a. There is in each a main air or train pipe, adapted to connect with a source of fluid pressure or air supply, and a "triple valve."

b. There is in each a reservoir, adapted to be connected with the source of fluid pressure or air supply through a "triple valve," and

also adapted to be attached to a car and be auxiliary to the main reservoir upon the engine, and is known as an auxiliary reservoir.

c. In each there is a brake-cylinder, provided with a piston and means for connecting the same with the brake-shoes of the wheels of the car, so that such brake-shoes may be applied to the wheels and released therefrom by the movement of the piston actuating the shoes in one direction and other well-known means actuating the said shoes in the opposite direction.

75 The above three devices or elements are substantially the first three of the combination of claim 1 of said patent 360,070.

d. In each there is a "triple valve," provided with a piston and a valve mechanism, the piston having two movements or traverses, one greater in extent than the other, the greater one including the lesser—the first or preliminary movement or traverse of such piston operating the valve mechanism for the admission of fluid pressure or air from the auxiliary reservoir to the brake-cylinder to perform the functions of an ordinary "triple valve" in the first two classes of work heretofore referred to, and the second or further movement or traverse of such piston operating the valve mechanism so as to open communication between the main air or train pipe and the brake-cylinder for the direct admission of fluid pressure or air from such pipe to such cylinder to perform the third class of work heretofore referred to.

In each the above four essential elements or devices I find to be combined together in substantially the same way, to perform substantially the same work, by substantially the same means, and in substantially the same manner.

In forming the above opinion as to the substantial identity between said defendants' quick-action triple valve, when connected as stated, and the combination of devices particularly pointed out in said claim 2 of patent 360,070, I took into consideration the several differences to which I referred when considering a similar question regarding the combination of devices of said claim 1, as well as the several facts bearing upon the materiality of such differences, and I do not think it necessary to again repeat them.

I am clearly of the opinion that the said "defendants' quick-action triple valve," when connected to a main air and train pipe, auxiliary reservoir and brake-cylinder, as illustrated in said "Exhibit Drawing of Defendants' Quick-action Triple Valve and Connections," is substantially identical with the combination of devices particularly pointed out in said claim 2 of patent

76 360,070, in all essential particulars, and that what differences in mere form there may exist are wholly immaterial when considering the substantial identity between said "quick-action triple valve," when connected as stated, and said combination of devices as particularly pointed out in said claim 2.

I have also made the comparison required by the question regarding the combination of devices particularly pointed out in claim 4 of said patent 360,070, and find that the said "defendants' quick-action triple valve," and the combination of devices particu-

larly pointed out in said claim 4 of said patent 360,070, resemble each other in having the following four essential elements or devices combined together in a single casing or chest to form what is known as a "quick-action triple valve," viz:

a. In each there is a casing or chest, provided with a chamber adapted to receive a piston, and have the same work therein; and also provided with ports and passages adapted to connect with an auxiliary reservoir, a brake-cylinder and the atmosphere, and also provided with passages leading to connections adapted to connect with a main air or train pipe and the brake-cylinder.

b. In each there is a piston fixed upon a stem, and adapted to work in a chamber in the casing or chest, and also to actuate an auxiliary valve or valve device.

c. In each there is a valve adapted to be moved by the piston, and to govern or control the ports or passages in the casing or chest leading to the connections with an auxiliary reservoir, a brake-cylinder and the atmosphere.

d. In each there is an auxiliary valve adapted to control or govern communication between the passages in the casing or chest leading to the connections with a main air or train pipe and a brake-cylinder.

77 In each, the above four essential elements I find to be combined together in substantially the same way, to perform substantially the same work, in substantially the same manner, and by substantially the same means.

In forming the above opinion, as to the substantial identity between said "defendants' quick-action triple valve," and the combination of devices particularly pointed out in said claim 4, I took into consideration the several differences to which I referred when considering a similar question regarding the combinations of devices of claims 1 and 2 of said patent 360,070, as well as the several facts bearing upon the materiality of such differences, and I will not repeat them.

I am clearly of the opinion that the said "defendants' quick-action triple valve" is substantially identical with the combination of devices particularly pointed out in said claim 4 of patent 360,070 in all essential particulars, and that what differences in mere form there may exist are wholly immaterial, when considering the substantial identity between said "quick-action triple valve" and said combination of devices as particularly pointed out in claim 4.

Int. 9. To what extent are the opinions expressed in your answer to interrogatory 8 as to "defendants' quick-action triple valve" applicable to and applied by you to the "quick-action brake-valve" of plate IX of defendants' 1889 catalogue, when connected to a main air or train pipe, auxiliary reservoir and brake-cylinder, substantially as illustrated in "Complainants' Exhibit Drawing Defendants' 1889 Quick-action Brake-valve and Connections?"

A. The said "Complainants' Exhibit Drawing Defendants' 1889 Quick-action Brake-valve and Connections" I understand to be the drawing which I stated in my answer to interrogatory 7, I would hereafter produce, and which, it will be remembered, was to be the

same as "Complainants' Exhibit Drawing Defendants' Quick-action Triple Valve and Connections," excepting that defendants' 1889 "quick-action brake-valve" was to be put in place of said defendants' 1891 "quick-action triple valve."

As I have heretofore stated, there is no substantial difference between the said defendants' 1889 "quick-action brake-valve" and said defendants' 1891 "quick-action triple valve," and therefore it follows that whatever I have said in my answer to Int. 8, or the opinions which I therein expressed regarding the substantial identity between said defendants' 1891 "quick-action triple valve" and the combinations of devices particularly pointed out in claims 1, 2 and 4 of said patent 360,070 apply with equal force and to the same extent when considering the substantial identity between said defendants' 1889 "quick-action brake-valve" and the combinations of devices particularly pointed out in claims 1, 2 and 4 of said patent 360,070.

Whatever differences there may exist between the said defendants' 1889 "quick-action brake-valve" and said defendants' 1891 "quick-action triple valve," to which I have heretofore referred, are differences which, in my opinion, are wholly immaterial, and would not in any way affect the substantial identity between said defendants' 1889 "quick-action brake-valve" and the several combinations of devices particularly pointed out in claims 1, 2 and 4 of patent 360,070, any more than the several differences pointed out between said defendants' 1891 "quick-action triple valve" and the same several combinations of devices; and my reasons are substantially the same for this opinion as those given in my answer to said Int. 8.

Int. 10. Will you please produce and briefly explain an illustration showing a quick-action triple valve of the construction set forth in patent 360,070, located in operative position in an automatic air-brake apparatus?

A. I do produce an illustration as requested in the question and will briefly explain the same.

The said illustration represents those portions of an automatic air-brake apparatus which are located upon the locomotive or engine, the engine tender and one passenger car, and I will separate the parts of the said apparatus located upon the engine, tender and passenger car, by marking the couplings in the main air or train pipe which separate to disconnect or uncouple the engine from the tender and the tender from the passenger car.

All of the several parts are in section, except the flexible hose, couplings and angle cocks, which connect the rigid portions of the main air or train pipe, and the pressure gauge and some of the connections located upon the engine. The coupling between the engine and tender I will mark A. The one between the tender and the passenger car, B, and the one leading from the passenger car to the next following car, C. The air-compressing engine or pump, which is located upon the engine, I will designate "air pump." The ordinary or plain triple valve located upon the tender of the engine I will designate "ordinary triple valve," and the quick-ac-

tion triple valve located upon the passenger car, "quick-action triple valve."

I will also mark the main air or train pipe "main air or train pipe."

The other portions of the said illustration are already marked or designated.

The "air pump," by means of which air is compressed, is suitably connected with the boiler of the engine or locomotive so as to receive steam therefrom and be operated. A governor is placed in such connection between the boiler and the air pump, by means of which the compressed air or fluid pressure in the main reservoir located upon the locomotive or engine regulates or governs the supply of steam to the air pump, so that such air pump is automatically stopped and started, or in a measure controlled, by the amount of fluid pressure which the air pump has forced into the main reservoir.

The operating cock or engineer's valve, by means of which the fluid pressure or compressed air in the main air or train pipe is varied to operate either the ordinary "triple valve" or the "quick-action triple valve" is arranged so as to be under the control of the engineer as occasion may require, either to admit compressed
80 air or fluid pressure from the main reservoir to the main air or train pipe, to increase the pressure therein and move the pistons of the "triple valves" in the forward direction, or permit main air or train pipe pressure to escape from such pipe and reduce the pressure therein, and move the pistons of the "triple valves" in their backward direction.

The pistons of both the ordinary "triple valve" and the "quick-action triple valve" are shown in the illustration at the extreme limit of their forward movement or stroke, as they would be when the train was in "running order," that is with the main air or train pipe and auxiliary reservoirs charged with fluid pressure or compressed air to the desired extent, such pressure being substantially equal throughout the train. The pistons of the brake-cylinders are shown in the position which they occupy when the brake-cylinders are free from pressure, or the pressure in them is that of the atmosphere, springs being used to return and hold them in such position upon the escape of fluid pressure from the brake-cylinders to the atmosphere.

The connections between the pistons of the brake-cylinders and the brake-shoes are not shown in said illustration, but are left to be supplied, of any well-known or convenient form.

The automatic control of the air pump, as before described, keeps the main reservoir upon the locomotive or engine supplied with the desired amount of fluid pressure, which is generally somewhat higher than that employed in the main air or train pipe, so that there can be an escape therefrom to the main air or train pipe up to the desired limit of pressure in such pipe, as it will be remembered that the escape of fluid pressure or compressed air from the main reservoir necessarily reduces the pressure therein in proportion to the escape therefrom; and if the pressure in the main reser-

voir did not exceed the desired limit of pressure in the main air or train pipe there could be no escape of fluid pressure from said main reservoir such as would increase the fluid pressure or compressed air in the main air or train pipe to the desired limit.

On the engineer's desiring to apply the brakes he would turn the handle of the engineer's cock or valve, so as to allow sufficient fluid pressure or air to escape from the main air or train pipe at the point of such cock or valve marked "Exhaust," to reduce the main air or train pipe pressure from two to five pounds, then closing his cock or valve, preventing further escape of main air or train pipe pressure, and the pistons of the several "triple valves," owing to the reduction of the main air or train pipe pressure to the extent named, would be moved backward sufficiently to cause the main valves of such "triple valves" to first close communication between the several brake-cylinders and the atmosphere, and then to open communication between the several auxiliary reservoirs and brake-cylinders, whereupon fluid pressure or air from such reservoirs would escape or expand into such cylinders, and such escape or expansion would reduce the pressure in such reservoirs slightly below the main air or train pipe pressure, which would result in the said triple-valve pistons moving in a forward direction, owing to the preponderance of pressure upon the main air or train pipe side of such pistons. This forward movement of the triple-valve pistons would cease when such movement had caused their main valves to close communication between the several auxiliary reservoirs and brake-cylinders, because there would be no further reduction of auxiliary reservoir pressure upon the closure of communication between them as stated, and therefore the triple-valve pistons would necessarily come to a state of rest owing to the equilibrium of pressure upon their two sides, and whatever fluid pressure had expanded or escaped into the several brake-cylinders from their several auxiliary reservoirs would be held and be operative therein in applying the brakes. The above operation is known as a "graduating" application, and if the pressure in the brake-cylinders does not sufficiently reduce the speed of the train or hold it in check upon a downgrade, the engineer allows another slight reduction in pressure equal to or less than the first one, as his judgment may dictate, whereupon the main air or train pipe pressure is reduced below that in the auxiliary reservoirs, and the pistons of the several triple valves move backward again sufficiently to again open communication between the auxiliary reservoirs and the brake-cylinders, whereupon another escape or expansion of auxiliary reservoir pressure takes place into the brake-cylinders, augmenting the force already there and increasing the force with which the brake-cylinder pistons cause the brakes to be applied to the wheels of the train. This second escape or expansion of fluid pressure or air from the auxiliary reservoirs to the brake-cylinders causes a second reduction in auxiliary reservoir pressure sufficient to cause the several triple-valve pistons again to move in a forward direction sufficiently to close communication between the auxiliary reservoirs and the brake-

cylinders. And as many of these "graduating" applications would be made as the judgment of the engineer dictated and the circumstances of the particular case required.

When the engineer desires to release the brakes of the train, he turns the handle of his operating valve or cock to the point where its ports and passages open communication between the main reservoir on the engine and the main air or train pipe, permitting sufficient compressed air or fluid pressure to escape therefrom into said pipe so as to increase said main air or train pipe pressure to the desired limit. Whereupon he closes said cock or valve, and the increased main air or train pipe pressure causes the several triple-valve pistons to move forward to their extreme limit of movement in that direction, which results in again opening communication between the several brake-cylinders and the atmosphere, and consequently the escape or expansion of the fluid pressure which had been operative in the brake-cylinders permits the coiled springs to again return the pistons of the brake-cylinders to the position shown in said illustration, and to release the brakes from the wheels
83 of the train and at the same time to permit the auxiliary reservoirs to be recharged with fluid pressure or air to the desired limit.

The above operation is known as "graduating," and is the first class of work to which I have heretofore referred.

As before stated, "service" stops, or the second class of work to which I have heretofore referred, can be made or performed by a series of two or more "graduating applications." Or such second class of work or "service stops" can be performed or made by the engineer turning his handle so as to cause a slow and steady escape of main air or train pipe pressure to take place through his operating cock or valve, and in this way cause the several triple-valve pistons to move backward and first close communication between the several brake-cylinders and the atmosphere, and then open communication between the several auxiliary reservoirs and the brake-cylinders. This slow and steady reduction of main air or train pipe pressure should substantially agree with the reduction of auxiliary reservoir pressure by its escape or expansion into the brake-cylinders so as to hold the several triple-valve pistons in position to keep communication open between the several auxiliary reservoirs and their brake-cylinders until the pressure therein has been equalized, that is, until a substantial equilibrium between the pressure of each auxiliary reservoir and its brake-cylinder is established, when the escape of main air or train pipe pressure should cease, for any further escape would be simply a waste and could serve no useful purpose.

With the desired limit of main air or train pipe pressure placed at seventy pounds, a reduction of such pressure to the extent of about twenty pounds will cause the triple-valve pistons to operate as just stated in making a "service" stop or performing the second class of work heretofore referred to, and the equalized pressure of the auxiliary reservoirs and their brake-cylinders would be about

- fifty pounds to the square inch, and any reduction in main air or train pipe pressure below that point would of course be useless and a waste.

To release the brakes the engineer would increase the main air or train pipe pressure to the desired limit, the same as when the first class of work or "graduating" was performed, and with like results.

In case a collision or other accident is to be avoided, and the train stopped in the shortest space of time, regardless of all other considerations, the engineer turns the handle of his operating cock or valve so that a sudden and considerable reduction of main air or train pipe pressure takes place in the train-pipe adjacent to the point of its escape, as, say, a reduction of twenty pounds, whereupon the piston of the first quick-action triple valve, as the one on the passenger car as shown in this illustration, is caused to quickly move to the extreme limit in its backward direction, thereby contacting or connecting with some portion of an auxiliary valve or valve device, or moving some portion of its valve mechanism to such an extent that communication is opened directly between the main air or train pipe before the main valve or valve mechanism operated or actuated by the triple-valve piston permits any substantial escape or expansion of auxiliary reservoir pressure into the brake-cylinders, to interfere with the admission of main air or train pipe pressure from such pipe directly into the brake-cylinders, which direct admission of main air or train pipe pressure causes a reduction of such pressure in such pipe adjacent to the first "quick-action triple valve," which reduction causes the next adjacent or succeeding "quick-action triple valve" to in like manner operate, and so on throughout the train supplied with "quick-action triple valves." This series of reductions in pressure in the main air or train pipe takes place without the fluid pressure or air traveling from the rear end of the train to a single opening at the engine, there being as many openings as there are "quick-action triple valves" in the train.

- The direct admission of main air or train pipe pressure to the brake-cylinders causes the pistons in such cylinders to apply the brakes with a greater force than is done in making a "service" stop, and with the train-pipe pressure of seventy pounds to the square inch, the equalized pressures in the auxiliary reservoirs and brake cylinders is in the vicinity of sixty pounds to the square inch in such brake-cylinders as receive such direct admission of main air or train pipe pressure, and the main air or train pipe pressure will be reduced to about forty pounds.

This operation is known as "quick action," and "triple valves" having the capacity of operating as just stated are known as "quick-action triple valves," and perform the third class of work heretofore referred to.

To release the brakes, when a "quick action" or "emergency stop" has been made, as just described, the engineer turns the handle of his operating valve or cock so as to open communication between the main reservoir and the main air or train pipe, and in-

crease the pressure in such pipe up to the desired limit, when the several triple-valve pistons will move forward to the extreme limit of their movement in that direction, as in the case of "graduating" or making "service stops," and in like manner release the brakes and recharge the auxiliary reservoirs.

It is customary for each passenger car to be supplied with a valve or cock known as a "conductor's valve," the handle of which valve can be operated by a cord extending throughout the length of the car, so that the conductor or another person can, by pulling upon said cord, operate said conductor's valve and open communication between the main air or train pipe and the atmosphere and cause a reduction in main air or train pipe pressure, which will operate the triple-valve piston of the "quick action triple valve" nearest the conductor's valve so opened, to operate as just described, which would in turn operate the next adjacent or succeeding "quick-action triple valve" in a manner similar to that just described. Such conductor's valve is so designated upon the said illustration.

86 If upon the breaking in two of the train, or any accident happening to the main air or train pipe, or its connections with the several "triple valves," or "conductor's valves," by means of which the main air or train pipe pressure is allowed to escape and become reduced, the "quick-action triple valves" nearest to such point of escape, no matter in what portion of the train it might take place, would operate as the first "quick-action triple valve" operated when the engineer permitted a sudden and considerable reduction of main air or train pipe pressure to take place at the engine, and the "quick-action triple valve" which operated first in either portion of the train would also cause the next adjacent or succeeding "quick-action triple valve" to operate as before described, and this would continue until all the triple valves throughout the entire train had operated, and applied the brakes in the shortest possible time and with the greatest available force.

One of the advantages of such "quick-action triple valves" is that their operation does not in any way impede the operation of the ordinary "triple valves," and also that the ordinary "triple valves" do not otherwise impede the operation of "quick-action triple valves," except that they lengthen the distance between the point of sudden reduction of main air and train pipe pressure and the point where the "quick-action triple valve" is located, and because of this fact cars equipped with the ordinary "triple valve" can be used in a train with cars equipped with "quick-action triple valves," and yet have the two kinds of "triple valves" operative for performing the first two classes of work heretofore referred to, and also have the quick action triple valves operative in an emergency to an extent at least proportionate to the number of such quick-action triple valves which are scattered through the train.

The air, before compression, contains more or less moisture, and therefore it is necessary to provide means for relieving the main air or train pipe, as well as other portions of the devices, where they do not readily drain into such pipe, of the water or fluid collect-
87 ing therein from such moisture. Two such devices are shown

in the said illustration, one of them being upon the passenger car and the other upon the tender, that upon the tender being designated "drip-cup" and the other "car drain-cup."

The illustration referred to by the witness is here put in evidence by counsel for complainant, and is marked "Complainants' Illustration Automatic Brake System."

Counsel for complainants here states upon the record that complainants will not ask for a decree upon the patent No. 168,359, nor upon the fifth claim of patent No. 360,070.

Adjourned to Wednesday, July 22, 1891, at 10.30 a. m., at the same place.

NEW YORK, *July 22, 1891.*

Met pursuant to adjournment.

Counsel present as at last meeting.

The witness produces the drawing referred to by him in the closing paragraph of his answer to Int. 8, and states that the same is on an enlarged scale and similar to "Complainants' Exhibit Drawing Defendants' Quick-action Triple Valve and Connections," except that the form and construction of defendants' 1889 "quick-action brake-valve," as illustrated in defendants' 1889 catalogue, are substituted in place of defendants' 1891 "quick-action triple valve," and states that said drawing correctly represents the connection of defendants' 1889 "quick-action brake-valve," with a main air or train pipe, auxiliary reservoir, brake-cylinder, and the atmosphere, as said "quick-action brake-valve" is employed in practice in an automatic quick-action brake apparatus.

88 The drawing referred to is offered and put in evidence by counsel for complainants and is marked:

"Complainants' Exhibit Drawing Defendants' 1889 Quick-action Brake-valve and Connections," R. H. Whittlesey, special ex'r.

Cross-examination by LYSANDER HILL, Esq., of counsel for defendants:

X Int. 11. In your examination-in-chief you have intimated your opinion that the 1st, 2d and 4th claims of the patent in suit are to be broadly construed, for the reason that, as you assume, Mr. Westinghouse was the first in the art to invent a quick-action triple-valve mechanism for air brakes. Inasmuch as this involves a question of law, and your opinion as to the scope of the claims in suit seems to be based in whole or in part on your understanding of such law, I desire to know what that understanding is. I therefore ask you whether it is your understanding that Mr. Westinghouse, if he was in fact the first in the art to invent a quick-action triple-valve mechanism, became thereby entitled in law to claim the quick-action result or effect, however produced, or, on the other hand, became entitled to claim only the mechanical devices and combinations of devices by which he enabled his triple valve to accomplish such result or effect?

A. As I understand the question, it does not commence with a

correct statement of my position, and in order that there may be no doubt on this point, I will briefly state it:

The fact that Mr. Westinghouse was the first to devise an automatic system of brakes in which the operation of one triple valve affected and quickened the operation of the next adjacent triple valve, and, in so doing, reduced the main air or train pipe pressure, so as to produce a like effect upon the next or adjoining triple valve, and thereby made what has become to be known as "quick action"

in automatic brakes possible, by simply varying the manner
89 in which the fluid pressure or air in the main or train pipe was controlled by the engineer upon the locomotive, had to do with the materiality of the several differences which I pointed out between said "defendants' quick-action triple valve," and the preferred form which the combination of devices particularly pointed out in claims 1, 2 and 4, were illustrated in the drawing of the said patent 360,070, and was not the only reason why such differences were immaterial when considering the substantial identity of the said defendants' quick-action triple valve, and the combination of devices particularly pointed out in said claims 1, 2 and 4, as clearly appears from what I have heretofore said.

In this connection it will be observed that in those portions of the specification which I have heretofore quoted regarding the object of the invention of said patent 360,070, and what it consists of when generally stated, which is as follows:

"The object of my invention is to enable the application of brake-shoes to car wheels by fluid pressure to be effected with greater rapidity and effectiveness than heretofore, more particularly in trains of considerable length, as well as to economize compressed air in the operation of braking by utilizing in the brake-cylinders the greater portion of the volume of air which in former practice was directly discharged into the atmosphere."

"To this end my invention, generally stated, consists in a novel combination of a brake-pipe, an auxiliary reservoir, a brake-cylinder and a 'triple-valve' device governing, primarily, communication between the auxiliary reservoir and the brake-cylinder; and secondarily, communication directly from the brake-pipe to the brake-cylinder."

It was in accordance with the instructions given in the above quotation as to the object of the invention, and what it consisted in, that I reached the understanding as to what the
90 several combinations of devices particularly pointed out in claims 1, 2 and 4 were, and if this understanding is what is referred to by the terms "broadly construed," then it is manifest that my understanding was not reached upon the assumption or even the fact that Mr. Westinghouse was the first in the art to invent a "quick-action triple-valve" mechanism for air brakes.

My understanding of the law as inquired about is that even with the fact, as I understand it to be, that Mr. Westinghouse was the first in the art to invent a "quick-action triple-valve" mechanism, that this fact does not entitle him to claim the quick-action result or effect however produced, if by these words no regard is

had to mechanism or means employed in producing such result or effect, for, as I understand it, "a result" or "effect" is not patentable.

My understanding is that Mr. Westinghouse is only entitled to claim the "mechanical devices" combined together by means of which he is enabled to accomplish the quick-action effect or result; or, in other words, that he is only entitled to claim mechanisms or instrumentalities combined together in substantially the manner set forth to accomplish such quick-action effect or result, and also that each individual mechanism or instrumentality may differ from the form in which he has seen fit to illustrate it, in the drawings of said patent, so long as such difference does not prevent the combinations of devices or mechanisms or instrumentalities, as a whole, from accomplishing such result or effect in substantially the same way as set forth in said patent 360,070.

X Int. 12. Assuming that Mr. Westinghouse was the first in the art to invent a quick-action triple-valve mechanism, do you understand that such fact would authorize the claims in suit to be construed more broadly than as expressed by their own terms?

A. I do not understand that the fact that Mr. Westinghouse was the first in the art to invent a "quick-action triple valve" or an automatic quick-action system of brakes, is a sufficient warrant for ignoring or overriding any of the terms expressed in any of the claims of said patent 360,070, if this is what is intended by the language of the question; but I do understand that such fact authorizes the widest range of mechanical equivalents within the terms of said claims, and therefore that the said claims are to be understood as being as broad as the terms themselves will warrant and are not to be limited by a prior state of the art.

X Int. 13. Do you understand that Mr. Westinghouse was the first in the art to combine "a brake-pipe," an "auxiliary reservoir," a brake-cylinder and a "triple-valve" device, governing, primarily, communication between the auxiliary reservoir and the brake-cylinder, and, secondarily, communication directly from the brake-pipe to the brake-cylinder?

A. Yes, I do.

X Int. 14. Inasmuch as the quotation contained in my last question is taken from the specification of the patent in suit, I will ask you what meaning you attach to the words "primarily" and "secondarily," contained therein. Do those words relate to the relative times or sequence of the functions referred to, or to their relative importance, or to their logical order of statement?

A. My understanding of the terms "primarily" and "secondarily," referred to in the question, is that the word "primarily" refers to the "primary" functions of a triple valve by means of which the two first classes of work heretofore referred to by me can be performed, and the word "secondarily" to the new or secondary function by means of which "quick action" as heretofore explained can take place, and the third class of work as heretofore explained can be performed.

X Int. 15. Omitting the words "primarily" and "secondarily," I will restate my 13th X Int. as follows, to wit:

Do you understand that Mr. Westinghouse was the first in the art to combine a brake-pipe, an auxiliary reservoir, a brake-cylinder, and a "triple-valve" device governing communication between the auxiliary reservoir and the brake-cylinder, and also governing communication directly from the brake-pipe to the brake-cylinders?

A. Yes, if there is to be any difference in the two "communications," which I understand is the case in the use of the word "directly" in connection with the last-named "communication," viz., communication directly from the brake-pipe to the brake-cylinder.

X Int. 16. That is to say, if a brake-pipe, an auxiliary reservoir, a brake-cylinder, and a triple-valve device are combined together in a brake mechanism, so that the triple-valve device governs communication from the auxiliary reservoir to the brake-cylinder, and also governs communication directly from the brake-pipe to the brake-cylinder, then, in such case, the combination embraces the invention set forth in the patent in suit, and, as you understand the art, Mr. Westinghouse was the first to produce such combination?

A. The present question, as I understand it, does not necessarily make any difference between the two "communications," that is, the "communication" between the main air or train pipe, auxiliary reservoir, brake-cylinder and atmosphere, and the direct communication from the main air or train pipe to the brake-cylinder, which two communications are indicated in Complainants' Exhibit Defendants' 1891 Catalogue, plate XI, by two series of arrows: one series, which is in full lines, indicating the first "communication," and the other, or series of arrows in broken lines, indicating the last or direct "communication." The language of the question is broad enough to include a construction where only the ordinary functions of a "triple valve," or where the first two classes of work heretofore referred to are performed, and where fluid pressure passing through the "triple-valve" device may reach both the auxiliary reservoir and brake-cylinder at the same time, but yet the air so entering the brake-cylinder is not utilized therein for any useful purpose in applying the brakes, nor would it in any way affect an adjacent "triple valve" so as to hasten or quicken its operation. In this last-named construction there is no difference between the two "communications"—in fact there is only one "communication"—and there is no "communication directly from the brake-pipe to the brake-cylinder," as I understand the term "directly" when read in the light of the preceding paragraph of the specification relating to the object of the invention.

From the above it will be seen that the several devices named in the question may be combined together so as to have one capacity, or radically another or entirely different one, and that this depends upon facts not stated in the question.

X Int. 17. My question stated, however, in plain terms, that the "triple-valve" device governed a communication from the auxiliary

reservoir to the brake-cylinder, and also a communication "directly" from the brake-pipe to the brake-cylinder—using the very terms found in the specification of the patent in suit on page 1, lines 20 to 27. I do not understand how you assume such two "communications" to consist, by any possibility, in only one "communication." Will you please explain yourself a little further on this point?

A. Upon reference to the previous question it will be seen that the language used is as follows, regarding the action of the triple valve—

"the triple-valve device governs communication from the auxiliary reservoir to the brake-cylinder, and also governs communication directly from the brake-pipe to the brake-cylinder."

And from this it will be seen that the previous question did not make it plain that there was two communications, and that only one communication would answer the language of that question, and because it would so answer it I answered the previous question in the manner in which that answer is found.

While it is true that some of the terms found in said previous question are found in the said specification, I did not then understand, nor do I now understand, that they are to be read in the light of the specification of patent 360,070, but that they are
94 to be read as they appear and without anything else to assist in explaining the exact meaning counsel may have had in mind.

If I am to understand by the present question that the previous one is to be read in the light of the specification of said patent 360,070, I desire to be now informed before proceeding further with the present answer, and will so request counsel to inform me.

X Int. 18. The specification, in the part to which I referred and from which I substantially quoted in my question, mentions a triple-valve device governing communication between the auxiliary reservoir and the brake-cylinder, and, if I understand the language employed, also governing communication directly from the brake-pipe to the brake-cylinder.

Using these terms in my question, without any mental reservation or qualification whatever, I merely asked you whether or not you understand Mr. Westinghouse to have been the first in the art to combine a brake-pipe, an auxiliary reservoir, a brake-cylinder and a triple-valve device governing communication between the auxiliary reservoir to the brake-cylinder, and also governing communication directly from the brake-pipe to the brake-cylinder—and, I confess, that I did not see, and do not now see, how a communication from the auxiliary reservoir to the brake-cylinder can be the same thing as a communication directly from the brake-pipe to the brake-cylinder, and, hence, I assumed them to be two "communications."

With this explanation, I ask you to answer the question again.

A. With the present explanation I understand that there are to be two "communications," and that they are to be different from each other, that is, a portion of one or the "communication directly"

is to be entirely different or separate from all portions of the other, and with such understanding I believe the fact to be that "Mr. Westinghouse was the first in the art to combine a brake-pipe, an auxiliary reservoir, a brake-cylinder and a 'triple-valve' device governing communication between the auxiliary reservoir and the brake-cylinder, and also governing communication directly from the brake-pipe to the brake-cylinder," as stated in X Int. 15.

X Int. 19. Then, if I understand you, it is an essential characteristic of Mr. Westinghouse's mechanical combination, distinguishing it from the prior art, that the communication "directly from the brake-pipe to the brake-cylinder referred to in lines 26-27, page 1, of the specification shall be "entirely different or separate from all portions of the other communication," to wit: the communication between the auxiliary reservoir and the brake-cylinder referred to in line 24-25 on the same page. Am I correct?

A. You are not correct, and I am wholly unaware of having said anything which would warrant such an understanding.

In my answer to the previous question, which related simply to the fact whether Mr. Westinghouse was the first to do certain things, I stated that with the explanation as then given by counsel, that in his statement of the fact, that a portion of one communication was to be entirely separate from all other portions of the other communication, which in reference to that fact, I believe to be true, but I did not say nor mean to be understood as saying that it was an essential characteristic or distinguishing feature of the combination of said patent 360,070 that such entire separation of a portion of one communication must necessarily be present in every structure which would be substantially identical with that of the several combinations of devices or mechanisms particularly pointed out in claims 1, 2 and 4 of said patent.

I think it will be manifest to a mechanic skilled in the art of automatic systems of brakes as the same existed prior to the date of said patent 360,070 and with the knowledge to be obtained from the said patent 360,070 that the two "communications" might be made with no one portion of one entirely separated from the other under all conditions of use, and yet have the structure perform substantially the same work, by substantially the same means, combined substantially in the same way, and to work in substantially the same manner.

It will also be observed that no such requirement is made by the terms of the several terms referred to.

In view of the above several facts it is not my opinion that it is an essential or characteristic feature of the several combinations of devices or mechanisms heretofore referred to, that some portion of the direct communication between the "brake-pipe," or as heretofore termed the main air or train pipe, and the brake-cylinder, must necessarily be separate and distinct from all portions of the other "communication," that is, from the auxiliary reservoir to the brake-cylinder.

X Int. 20. In this specification, page 1, lines 20 to 28, Mr. West-

inghouse is trying to state, in general terms, what his invention consists in; and I am trying to find out what he means by this statement, and not what the claims mean, nor what a mechanic skilled in the art may understand from something else.

In order to understand the meaning of the statement of Mr. Westinghouse, I desire to ascertain, first, how broadly this statement could be interpreted, in view of the state of the art, and yet be true. I confess that I do not understand the distinctions which you have made, and I will, therefore, ask you again: Was Mr. Westinghouse the first in the art to combine a brake-pipe, an auxiliary reservoir, a brake-cylinder and a triple-valve device governing communication between the auxiliary reservoir and the brake-cylinder and communication directly from the brake-pipe to the brake-cylinder—whether those two “communications” were entirely separate from each other or partially coincident with each other?

A. Upon turning to that portion of the specification referred to in the question, it will be found that a portion of Mr. Westinghouse's statement has been omitted in the present question, the same as in some of the preceding ones, which omitted portions I have heretofore given my understanding of, which I think makes perfectly plain my understanding of what is meant by the statement found in the specification which is referred to in the question.

If this is what counsel desires I will refer him to that answer for such understanding.

If he desires to know simply the fact whether Mr. Westinghouse was the first in the art to devise an automatic system of brakes made in accordance with a portion of the statement as found in the specification, which portion is named in the present question, that will depend wholly upon what meaning may be put upon certain words contained in that portion, and which I have tried to make plain in my previous answers, but from the statements found in the present question, it appears that I have not been successful.

I will again attempt to make this matter plain. As I now understand the matter there are to be two “communications” between the brake, main air or train pipe and the brake-cylinder, one of which is from such pipe to the auxiliary reservoir and thence to the brake-cylinder, by means of which fluid pressure or air from the auxiliary reservoir is admitted to the brake-cylinder upon a reduction of the pressure in the brake, main air or train pipe below that in the auxiliary reservoir, and by means of which the two first classes of work heretofore referred to are performed; the other of which is from such pipe directly to the brake-cylinder without the fluid pressure which is to pass through the direct communication being able to enter the auxiliary reservoir, for if it did so enter it would not be a direct admission from such pipe to such cylinder.

In order that these two communications between the brake, main air or train pipe and the brake-cylinder may be had, it is necessary that some portion of one “communication” shall be separate from all portions of the other “communication,” or shall be different in extent, which difference in extent is substantially making that por-

tion which does differ, to the extent of its difference, separate from all portions of the other "communication."

98 With this understanding, Mr. Westinghouse was, so far as I am able to learn, "the first in the art to combine a brake-pipe, an auxiliary reservoir, a brake-cylinder and a triple-valve device governing communication between the auxiliary reservoir and the brake-cylinder, and communication directly from the brake-pipe to the brake-cylinder," so as to accomplish the object set forth on page 1 of the specification, lines 10 to 19, inclusive, of said patent 360,070.

Answer objected to as evasive and not responsive.

X Int. 21. Mr. Westinghouse either was or was not the first in the art to broadly combine, in an automatic brake mechanism, the following elements, to wit: A brake-pipe, an auxiliary reservoir, a brake-cylinder, and a triple-valve device governing communication between the auxiliary reservoir and the brake-cylinder, and also governing communication directly from the brake-pipe to the brake-cylinder.

I simply want to know whether he was or was not the first in the art to broadly combine the elements which I have stated in my question.

If you know the fact you can fully answer the question by yes or no; and if you don't know, you can say so.

I want an answer to the question, which I now repeat.

A. I have at no time attempted nor have I any desire to evade answering the preceding question, nor any other which has been asked me, and I have attempted to make my answers responsive to the other questions.

It will be remembered that at the beginning of the questions relating to this subject, that I pointed out the fact to be that, under one understanding of substantially the same question when broadly considered, that Mr. Westinghouse was not the first to combine those several elements regardless of the manner in which they were combined, and thereupon counsel, as I understood it, dis-

99 claimed any such broad interpretation of his language, and that the question was to be answered with the understanding that there was to be "two communications," under which understanding of the question I have heretofore answered.

As I understand him now he wants the question answered broadly, without any reference to the way in which they are combined, or whether they are two separate communications or only one, or to accomplish the object set forth in that portion of the specification of patent 360,070, to which I referred in my preceding answer.

Answering the question broadly, as I thus understand it, I should answer it no, as I have in substance heretofore done, but answering it when the several elements are combined together to accomplish the object set forth in the specification, I should answer it yes.

It will be observed that after stating the object of the invention, the specification goes on to say:

"To this end my invention, generally stated, consists in a novel combination," &c.

X Int. 22. Inasmuch as Mr. Westinghouse was not the first in the art to broadly combine, in an automatic air-brake mechanism, the elements named in my last question, will you state where, in the prior art, that broad combination is to be found?

A. I believe it is to be found in British letters patent of about the year 1879.

X Int. 23. And when Mr. Westinghouse stated in line 21, page 1, of his specification, that his invention, "generally stated," consisted in a "*novel* combination" of the elements named in my last two questions, he is to be understood as implying, in accordance with the known state of the art, that his invention did not consist broadly in a combination of the elements named, but only in their combination in a particular way; am I correct?

A. If the term "broadly" means that the several elements, no matter how combined, or what object is to be accomplished, I think he is to be understood as implying that his invention lay in the combination to which he refers by means of which the object stated could be accomplished, and that it did not lay in any and every combination of these parts by means of which other and radically different objects could be obtained, or, in other words, that his invention lay or consisted in the combination of such parts, by reason of which combination the object stated in the specification is accomplished and what has become known as "quick action," or the third class of work heretofore referred to is accomplished.

I understand that every combination of mechanisms or instrumentalities is a combination in a "particular way," in so far that every combination which is substantially identical with it must be combined in substantially that way.

If this is which is meant by the term "particular way" in the present question, it is manifest that it does not differ from what I have just heretofore stated the invention of Mr. Westinghouse consisted of.

If, on the other hand, the term "particular way" in the present question is to be understood as meaning that some one or more of the mechanisms or instrumentalities mentioned in the last few preceding questions are to be in themselves limited or constructed otherwise than as stated in such questions, then I should answer that the invention of Mr. Westinghouse did not consist in combining such several mechanisms or instrumentalities in such a "particular way."

Adjourned to meet at same place, tomorrow, July 23d, 1891, at 10 o'clock a. m.

R. H. WHITTLESE,
Special Examiner.

101

NEW YORK, *July 23d*, 1891.

Met pursuant to adjournment.
Counsel present as at last meeting.

Cross-examination of the witness HENRY F. NEWBURY resumed:

X Int. 24. In the specification of the patent in suit, page 4, lines 91 to 103, there is a statement in the nature of a disclaimer, in the following words, to wit:

"I am aware that a construction in which 'an always-open one-way passage' from the main air pipe to the brake-cylinder is uncovered by the piston of the triple valve simultaneously with the opening of the passage from the auxiliary reservoir to the brake-cylinder has been heretofore proposed, and such construction, which involves an operation different from that of my invention, I therefore hereby disclaim."

I suppose you understand that the construction here referred to as existing in the prior art was the construction patented to George A. Boyden, June 26th, 1883, No. 280,285, for improvements in fluid-pressure brakes, do you not?

A. I understand that the said patent of Boyden was the particular cause of the statement quoted in the present question being placed in said patent 360,070.

I also understand that it has reference to any construction other than that set forth in the Boyden patent which comes within its terms, such as, for instance, as one of the constructions set forth in the British letters patent heretofore referred to by me as being granted about the year 1879.

X Int. 25. There are several mechanical terms and expressions in the patent in suit whose exact definition and meaning I wish to make clear to the court, not by prolix discussions of their functions and surroundings, but by concise and clear definitions, and
102 by brief and direct answers to such questions as I shall ask, and by these words I mean no reflection whatever, but simply indicate what I want to get at.

For example, claim 1 of the patent speaks of "a triple valve," and claim 4 speaks of "a triple-valve device." Do you understand these two expressions as used in said two claims to mean one and the same thing, or that there is any difference in their meaning?

A. I will endeavor to make my answers as brief as the nature of the questions will permit, and yet give a clear understanding of what I understand the meaning of the terms to be, but it must be borne in mind that every term has different meanings, in a measure, when used under different circumstances, and in connection with different language. It will also be borne in mind that it is somewhat difficult to express these different meanings in language, without more or less explanations.

I simply mention these facts to show that what counsel requires is a somewhat difficult matter, and that while I may appear to go

beyond the limits he has seen fit to name, that I do so only in an endeavor to make my understanding clear.

The specification of the patent itself as I have heretofore stated, defines what was referred to therein by the terms "triple valve" and "triple-valve device," which is probably as concise and brief a statement as I could make, therefore I will again quote it at this point.

"In using the terms 'triple valve' and 'triple-valve device,' I refer to a valve device, however specifically constructed, having a connection with the main air or brake pipe, another with the auxiliary reservoir or chamber for the storage of power, and another with a brake-cylinder or its equivalent for the utilization of the stored power, and with a release or discharge passage for releasing the operative power from the brake-cylinder, whether the valves governing these passages or connections are arranged in one or more cases and are moved by a piston or its equivalent, or by a series of pistons or their equivalents, there being numerous examples in the art, of constructions varying materially in appearance, whereby these functions are performed, both in plenum and vacuum brake mechanisms."

I understand these "functions" referred to in the above quotation are the ordinary functions of a "triple valve," as I have heretofore explained them, and by means of which the two first classes of work heretofore referred to by me are performed.

The term "triple valve," as the same is used in claim 1 of said patent 360,070, as I understand the same, is one of these mechanisms which has the capacity of performing the functions referred to in the above quotation, as I have explained the same, and which "triple valve" forms one of the mechanisms or instrumentalities which are to be combined in a brake mechanism with the other mechanisms or instrumentalities therein named in the manner set forth in the specification of said patent 360,070.

The term "triple valve," as used in said claim 1 of patent 360,070, may be in a single case, casing or chest, or it may be in a portion of a case, casing or chest, which also contains all of the other mechanisms or instrumentalities specified in said claim 1, but, whether in a case, casing or chest, which also contains the other mechanisms or instrumentalities specified in said claim, or in a separate case or otherwise, it is to have the capacity of performing the ordinary functions of a "triple valve" as I have heretofore explained them, and also have the capacity of actuating an auxiliary-valve device through a contact or connection with the piston of the "triple valve."

The term "triple-valve device," as the same is found in the said claim 4 of patent 360,070, it will be observed, is used in connection with the following words:

"4. The combination, in a triple-valve device, of a case or chest," and then follows the other mechanisms or devices particularly pointed out in said claim 4.

From this it will be seen that the several mechanisms or instrumentalities particularly pointed out in said claim 4 are to be com-

bined together in a "triple-valve device," and that one case, casing or chest is to contain all the several mechanisms or instrumentalities named in said claim 4 of patent 360,070, and, therefore, the said claim 4 is necessarily limited to having its several mechanisms or instrumentalities combined in one case; that is, combined with the operative parts of a "triple valve."

The "triple-valve device" of the said claim 4 is necessarily a device which not only performs the ordinary functions of a "triple valve" as heretofore explained by me, but also has the capacity of performing another and distinct function, which function is that now known in the art as "quick action."

I understand the term "triple-valve device," as the same is used in said claim 4, to be the same as if the words "quick action" had been prefixed thereto, so as to have the words of said claim quoted in the present answer read as follows:

4. The combination, in a quick-action triple-valve device, of a case or chest.

From the above it will be seen that there is a difference in the meaning of the two terms "triple valve" as used in claim 1, and "triple-valve device" as used in claim 4 of said patent 360,070; that is, while both of them have the capacity of performing the ordinary functions of a "triple valve," and in this respect are alike, yet they differ in that one has an additional function from the other.

X Int. 26. So, also, I find in claim 1 the expression, "an auxiliary-valve device," and in claim 4 the expression, "an auxiliary valve." As employed in said two claims, are these two expressions synonymous, or of different meaning?

105 A. As I understand the term auxiliary-valve device as the same is used, it is broad enough to cover not only the valve itself, but its casing or chest and necessary connections with the several parts named in the said claim 1, while in the case of the term "auxiliary valve" as used in said claim 4, I understand that it refers more particularly to the valve itself, the casing or chest of which is a portion of the casing or chest of the "triple-valve device," in which the "auxiliary valve" is combined and located.

In the above respect the terms "auxiliary-valve device," and "auxiliary valve," as the same are used in the claims 1 and 4 respectively, are somewhat different in meaning, although they refer to substantially the same things, for it is manifest that in order to have a valve perform functions of such a device it must be supplied with a casing, otherwise it would be impossible for it to perform such functions.

While the two terms differ somewhat, as before stated, the term "auxiliary-valve device" includes the term "auxiliary valve," or, in other words, the former term is somewhat broader in scope than the latter one, as the two terms are used in claims 1 and 4 of said patent 360,070.

X Int. 27. Do you understand the term "auxiliary-valve device," as used in claim 1, to include the valve itself, the air passage

controlled by said valve, and the check-valve arranged in said passage?

A. I do not understand that the check-valve, which is arranged in the passage leading directly from the brake, main air, or train pipe to the brake-cylinder, is necessarily a portion of the auxiliary-valve device of claim 1 of patent 360,070, as I fully stated in my direct examination when considering such claim.

The check-valve referred to in the question I understand to be check-valve 49 in the form in which the patentee saw fit to illustrate his invention in the drawings of said patent 360,070, which check-valve is especially designed, as I understand it, to serve the purpose of holding fluid pressure or air in the brake-cylinder upon the breaking in two of the train, or the bursting of the brake, 106 main air, or train pipe, so that the fluid pressure or air in such pipe is allowed to escape or be so greatly reduced from any cause that the brakes would not be applied by reason of the escape of the auxiliary reservoir pressure from the brake-cylinder as fast as it expanded or escaped into it, except for the use of said check-valve.

X Int. 28. Do you understand the expression, "auxiliary valve," as used in claim 4, to include said check-valve?

A. I do not understand that the term "auxiliary valve," as used in said claim 4, to include the check-valve to which I referred in my previous answer, and which I understand to be the check-valve referred to in the present question.

X Int. 29. In your opinion, would the Westinghouse quick-action device, in the form shown in the patent in suit, be a practical device without said check-valve or its equivalent—all the other parts being present and constructed and arranged as shown in the drawings of said patent?

A. I would ask counsel to define his meaning of the term "practical device," before proceeding with my answer.

X Int. 30. When I asked whether it would be a practical device, I mean would a device so constructed be successful and satisfactory in practice, as an air-brake mechanism on railway trains; or, in other words, would it be such a device as railroad companies would be likely to adopt and use?

A. As I understand the term as now defined by counsel, it takes in the widest possible range of all things which would go to induce a railroad company to adopt the device inquired of, regardless of whether such device would perform a useful function or not.

I think at the present day that any railroad company would be extremely loth to adopt any air-brake system in which there was no provision made for stopping the detached portions of a train upon such train breaking in two, and that any device which had this defect would not be likely to be adopted by railroad com- 107 panies at the present time, no matter what the other good qualities of the device or system might be.

X Int. 31. Then this check-valve or its equivalent is practically indispensable to the use of the quick-action device of the patent in suit, is it not?

If the term "practically indispensable" has reference to whether a railroad company would adopt the device or not, as I understand the term to be in the present question, it follows that provision, whether the mechanical equivalent or not for the check-valve, would have to be employed, so that trains, when they are stopped in two, may have their detached portions stopped, before railroads companies would be likely to adopt such device, notwithstanding the fact that they might recognize at once the useful functions performed by such quick-action device unprovided with a check-valve or some other means of preventing the escape of fluid pressure or air from the brake-cylinders, as heretofore described.

Int. 32. Are not locomotive engineers, in making emergency stops, liable to reduce the train-pipe pressure to such an extent that the said check-valve or its equivalent is necessary to prevent reflux of the air from the auxiliary reservoir and brake-cylinder in ordinary use of the quick-action system?

It is possible, I believe, for a locomotive engineer under the circumstances of a pending accident to so reduce main air or train-pipe pressure that there may be some "reflux of air," which I understand to be an escape or expansion of fluid pressure or air from the brake-cylinders to the main air or train pipe, but this could occur after the "quick action" had taken place throughout the length of the train, and the brake applied to the several cars of the train in much quicker time than was possible with any system of brakes before known, which fact alone would be of great consequence in the saving of life, and, what is more, I believe the brakes could be applied with greater force than would be possible in making a "service stop," or in any automatic system devised prior to that of the said Westinghouse system.

It will be borne in mind that whatever "reflux of air" or escape or expansion of fluid pressure which may take place from the brake-cylinders back to the brake, main air or train pipe, does not escape therefrom, but augments the pressure still remaining therein, and causes the pistons of the several "quick-action valves" to be forced forward, so as to close the opening of communication governed or controlled by the auxiliary valve or auxiliary-valve device, before all of the pressure or air which first escaped from such pipe to the brake-cylinders to return, and whatever amount of such first direct admission or escape of main air or train pipe pressure, which took place from such pipe to the brake-cylinders which did not return, would remain in such cylinders and augment the pressure or air escaping or expanding from the auxiliary reservoirs into such cylinders and increase the force with which the brakes would be applied to the wheels of the train to an extent corresponding to the amount of main air or train pipe pressure which remained in the brake-cylinders.

Another fact which would enable the brakes to be applied with greater force in making an "emergency stop," with the said check-valve 49 omitted from the structure, than is possible when making a "service stop," is that the main air or train pipe pressure which is allowed to suddenly escape at the engine to the extent of reduc-

ing the pressure or air in such main air or train pipe to the extent of 20 pounds, as explained by me in my direct examination, reduces such main air or train pipe pressure to such extent only at a point adjacent to its escape at the engine, and not throughout the entire length of the train as is necessary when making a service stop. Therefore a very much smaller amount of fluid pressure is allowed to escape from the main air or train pipe to the atmosphere, as a whole, when making an "emergency stop," as above stated, than when making a service stop, and from this it results that the fluid pressure or air to be utilized in applying the brakes is greater
 109 in the case of an "emergency stop," for this reason alone, than it is when making a "service stop."

From the above it will be seen that while some "reflux of air" or return of fluid pressure or air may take place from the brake-cylinder to the main air or train pipe, yet such "reflux" or return does not prevent the said quick-action triple valve unprovided with the check-valve 49, from serving an exceedingly useful purpose and performing work never before accomplished by any automatic system before known.

X Int. 33. Then, if I understand you, you think it would be entirely practical to use on railway trains the quick-action device of the patent in suit, with the check-valve 49 omitted, were it not for the danger of the train becoming accidentally broken in two or the train-pipe ruptured; am I correct?

Counsel for defendant states that this question does not need nor call for a repetition of the endless discussion to which we have been listening, but is a plain, simple, direct question that can be fully answered inside of three minutes. The witness, however, demands an adjournment for lunch before answering the question, or at least a good reason for requiring the question to be answered before lunch; and intimates that the answer is to be a very long one.

Counsel is willing to give the reason for requiring the question to be answered now, which is, that if it be answered fully and fairly, it will close the discussion on this point, so that after lunch we can take up another subject of inquiry.

Counsel therefore insists upon the question being answered before adjournment.

Counsel for complainants does not recognize the right of counsel for defendants either to limit the time in which questions shall be answered or to dictate the hour of adjournment for lunch. Such adjournment being, as counsel understands, merely a matter of mutual convenience, and it now being 1.10 p. m., about the
 110 hour at which adjournment is usually made, there does not seem to be any good reason for deferring an adjournment if the witness desires one to be made now, and the examiner is requested to so note.

Defendants' counsel replies that he has no desire to dictate the length of the witness' answer, but he does most emphatically protest against the further continuation of the abuses to which counsel has been already subjected in being obliged to listen to irrelevant

and not responsive interminable discussions where the question calls for simple, direct answers, and anything more than such an answer is a useless waste of time, simply annoying to the examining counsel and expensive to both parties. And with this statement he leaves the witness to decide whether he will answer the question or insist upon an adjournment.

Witness states that it is considerably over three hours since the present session commenced, and counsel states that if the present question is not answered in what he terms "fully and fairly," that the present answer will not close his discussion on the present point, and, therefore, it may continue indefinitely; he desires that the adjournment for lunch take place at this time.

Adjourned at 1.20 p. m. until 2 o'clock p. m.

R. H. WHITTLESEY,
Special Examiner.

Met at 2 o'clock p. m. pursuant to adjournment.

A. Understanding the term "practical" used in the present question as the same as defined in substance by counsel in a previous

question, I do think that the main objection, and, in fact,

111 substantially the only objection, railroad companies would

have to the adoption of "the quick-action device of the patent in suit, with the check-valve 49 omitted," is the fact that without such check-valve or some other means provided to prevent the return or escape of fluid pressure or air from the brake-cylinders to the brake, main air, or train pipe, and thence to the atmosphere upon the occurrence of the breaking in two of the train, or the rupturing of such pipe, and thus giving a free and unobstructed escape of fluid pressure or air from such pipe to the atmosphere, and thus preventing the application of the brakes to the separated portions of the train as heretofore explained.

In connection with this opinion I desire to call attention to the fact that this "quick-action" feature of "the quick-action device of the patent in suit with the check-valve 49 omitted" would be very useful when applied to railway trains in connection with the ordinary automatic system of brakes, each system being separate and distinct from the other, and that trains so equipped would provide for all contingencies, and if no better application of the quick-action principle had been devised, that some railroads, in my opinion, would probably adopt it in that form, but this would hardly be the case with a cheaper and simpler application of the quick-action principle as, for instance, such a one as disclosed in the preferred form of the patentee Westinghouse, and which is illustrated in the drawings of the patent in suit, wherein full provision is made for the contingency of the breaking in two of the train or the rupturing of the brake, main air, or train pipe, as well as the application of the quick-action principle to substantially its full extent.

Of course, with the choice of either the preferred form of the invention of the patent 360,070, or the form named in the present question, where the check-valve 49 is omitted or a substitute for it,

which would prevent the "reflux of air" or return of fluid pressure of air from the brake-cylinder to the main air or train pipe upon the breaking in two of the train or the bursting of the main air or train pipe, combined with the old automatic system, as I have just heretofore described, there is no doubt in my mind but what railroad companies would every time adopt the said preferred form, for the reason it is cheaper, simpler, and would under all circumstances apply the brakes with as much or greater force than the other form, which is the form wherein check-valve 49 is omitted and includes the old automatic system of brakes as above described.

From this it will be seen that the omission of the check-valve 49 may not be the only reason why railroad companies would not be likely to adopt "the quick-action device of the patent in suit with the check-valve 49 omitted," and that other considerations, such, for instance, as cheapness or better application of the quick-action principle, might, and, in my opinion, probably would, influence them in reaching a decision upon the matter, and such a decision is what I understand counsel to mean by the term "practical," as the same is used in the present question.

Defendants' counsel requests the examiner to note that this last answer commenced at 2.02 o'clock and ended at 2.39 o'clock.

X Int. 34. You have several times in your testimony mentioned "the preferred form" of the quick-action device of the patent in suit; do you find in this patent more than one form of quick-action device referred to, or any intimation that Mr. Westinghouse at the date of that patent knew of more than one form of quick-action device, except the suggestion on page 4 of the specification, lines 85 to 93, to wit, in substance, that the device may be used with air pressure, or with "atmospheric pressure"?

A. I do find more than one form referred to, and also exceedingly distinct intimations that Mr. Westinghouse, at the date of said patent 360,070, knew of more than one form of such quick-action device.

X Int. 35. Designate all such passages in the specification?

113 A. In the first place the several claims particularly point out different forms of a quick-action device, each one differing from the other, therefore, the claims alone refer to more than one form of quick-action device, and I cannot understand how the patentee, Westinghouse, could make those claims without his knowing of at least as many different forms as are particularly pointed out in the said several claims, and, therefore, there are distinct intimations found in the patent itself that Mr. Westinghouse knew of more than one form of such quick-action device.

The specification of said patent 360,070 contains the statements which I have quoted in full at least twice during my deposition, and also otherwise referred to quite a number of times therein, which statement will be found on page 4, beginning at line 68 and ending at line 85 thereof, wherein it is specifically stated in substance that one of the essential devices, mechanisms or instrumen-

alities may vary within limits therein defined, and each of such variations would be a change in the form and arrangement of certain parts of such essential device, mechanism or instrumentality, which would be in effect a change in form of a quick-action device, and in effect the statement that he knew of as many different forms as existed in the prior art of "triple valves;" and such statement is also a reference to other forms of such quick-action device.

The statement of the object of the invention, taken in connection with what it consists in when generally stated, as the same is found on page 1, lines 10 to 27 inclusive, is a distinct intimation that the patentee Westinghouse knew of more than one form of quick-action device, for, if such was not the case, I cannot understand why he should be particular to put in the words "generally stated" as those words are found in lines 20 and 21 of page 1 of the specification of said patent 360,070.

It will be observed that on page 1, lines 96 to 98 inclusive, of said patent 360,070, it is stated that—

"In the accompanying drawings figure 1 is an inverted plan view illustrating the application of my invention;"

114 and that it does not state that figure is an illustration of the invention; also that on page 2, lines 7 to 51 inclusive, states that,

"In the practice of my invention, each railroad car 1—

Counsel for the defendant interrupts the witness to inquire if he proposes to consume the time in quoting on the record forty-four printed lines of the specification which the court and all parties interested can readily find and read in the patent exhibit in evidence. If he does, counsel objects.

Witness states that he had not any intention of quoting the entire paragraph referred to, but that he named the lines wherein the matter would be found, so that it could be referred to without delay if thought necessary; and he also states that he has no desire to consume the time, as intimated by counsel for defendants, as the amount of work accomplished each day will, in his opinion, show a desire to expedite matters as far as circumstances will permit.

(Witness resumes:) "on which it is applied, as heretofore, provided with a main air pipe, 2, governed, &c."

naming the several parts in like order, being careful to, in each case, say, *a main air pipe, an auxiliary reservoir*, instead of saying *the main air pipe, the auxiliary reservoir*, &c., which is clearly an intimation that these several parts may be of a different form than what they are shown in the drawings of the patent 360,070, and therefore an intimation that the patentee had in mind or knew of other forms.

In the same paragraph will be found the following words, after setting forth the functions "of a triple valve 10":

115 "the triple valve 10 accords substantially with that set forth in letters patent of the United States No. 220,556, granted

and issued to me October 14th, 1879, and is not, therefore, saving as to the structural features by which it performs the further function of effecting the direct admission of air from the main air pipe to the brake-cylinder, as presently to be described, claimed as of my present invention."

This statement is explicit that the illustrated form of "triple valve" is not of the invention which the patentee Westinghouse was to claim in said patent 360,070, and is, to my mind, a distinct intimation, to say the least, that he, the patentee, knew of a different form than that illustrated, and that he wished it to be distinctly understood that such illustrated form was the form in which he preferred to illustrate his invention.

The specification of said patent 360,070, page 2 thereof, commencing at line 52, states as follows:

"The case or chest in which the operative mechanism of the triple valve proper, 10, is mounted, is fixed under or on the car body in any convenient position relatively to the auxiliary reservoir 6 and brake-cylinder 7, being in this instance shown as secured directly to one end of the auxiliary reservoir, in line axially therewith and with the brake-cylinder, which is secured to its opposite end."

This statement is, to say the least, an intimation that the devices or mechanisms named therein might be differently arranged from what they are shown in the preferred or illustrated form found in the drawing of patent 360,070, and when taken with other portions of the specification to which I have referred, is an intimation that the patentee Westinghouse knew of another form or arrangement of parts of a quick-action device, than that particularly illustrated in said drawing.

116 In the specification of the patent 360,070, on page 3, thereof, lines 37 to 47, inclusive, reference is made to three several letters patent, one of which is the one 220,556, before referred to, the other two being Nos. 168,359 and 172,064, and it is stated in substance that the form of "triple valve" set forth in said three patents accords in all substantial particulars with the form of "triple valve" illustrated in the drawings of said patent 360,070 as the same has been described in that portion of the specification preceding the reference to these three patents.

From an inspection of these three several patents just referred to, it will be seen that the "triple valves" therein set forth vary somewhat in construction, which being the fact, the statement referred to is an intimation that the patentee Westinghouse knew of more than one form of "triple valve" which might form one of the essential devices, mechanisms, or instrumentalities which go to make up a "quick-action" device.

The above I believe are all the portions or passages of the specification itself, aside from the general principle that the patentee is only required to show and describe one form in which he sees fit to embody his invention, that I find make reference to more than one form of quick-action device, or give intimation that Mr. Westinghouse at the date of that patent knew of more than one form of

quick-action device, of course keeping in mind the exception named in the question.

Adjourned to meet at same place tomorrow, Friday, July 24, 1891, at 10 o'clock a. m.

R. H. WHITTLESEY,
Special Examiner.

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NEW YORK, July 24, 1891.

Met pursuant to adjournment.
Counsel present as at yesterday's meeting.

Cross-examination of the witness HENRY F. NEWBURY resumed:

X Int. 36. You have stated that by the backward movement of valve 41 (which is the auxiliary valve of complainants' patent in suit) there is practically an open passage from the main air or train pipe to the brake-cylinder, through the ports and passages and chambers 17-18-20-11-42-43-46-47 and 48, so that main air or train pipe pressure can, under certain conditions pass directly to the brake-cylinder.

I now ask you if those parts which you have designated by numbers as referred to above, together with the valve 41, constitute the "auxiliary-valve device" named in claim 1 of the patent in suit?

A. I believe that the designation of the several passages, ports and chambers, as stated in the question, occurred in that portion of my deposition wherein I described the construction and operation of the preferred or illustrated form of the invention, that is, the form in which the patentee saw fit to adopt as one embodiment of his invention, so that it might be fully described.

I do not understand that the "auxiliary-valve device" of the said claim 1 of patent 360,070 is necessarily to be provided with all of such ports, passages, &c., for upon turning to said claim it will be there seen that the only requirements in terms of the "auxiliary-valve device," are to be that it is to be independent of the main valve of the "triple valve," and is to be so actuated by the piston of the "triple valve," so that it will admit air in the application of the brake directly from the main air or train pipe to the brake-cylinder.

The preferred or illustrated form of the invention of the patent in suit has the several passages, ports and chambers named in the question, some of which are common to the passages and ports and chambers leading from the main air or train pipe to the auxiliary reservoir, and when a passage is open from the main air or train pipe to the auxiliary reservoir, main air or train pipe pressure would pass through the portions common to both passages.

From all of the above I think it will be manifest that all of the several parts forming the practically open passage from the main air or train pipe to the brake-cylinder which I designated by numbers when describing the illustrated or preferred form of the inven-



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and issued to me October 14th, 1879, and is not, therefore, saving as to the structural features by which it performs the further function of effecting the direct admission of air from the main air pipe to the brake-cylinder, as presently to be described, claimed as of my present invention."

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This statement is, to say the least, an intimation that the devices or mechanisms named therein might be differently arranged from what they are shown in the preferred or illustrated form found in the drawing of patent 360,070, and when taken with other portions of the specification to which I have referred, is an intimation that the patentee Westinghouse knew of another form or arrangement of parts of a quick-action device, than that particularly illustrated in said drawing.

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From an inspection of these three several patents just referred to, it will be seen that the "triple valves" therein set forth vary somewhat in construction, which being the fact, the statement referred to is an intimation that the patentee Westinghouse knew of more than one form of "triple valve" which might form one of the essential devices, mechanisms, or instrumentalities which go to make up a "quick-action" device.

The above I believe are all the portions or passages of the specification itself, aside from the general principle that the patentee is only required to show and describe one form in which he sees fit to embody his invention, that I find make reference to more than one form of quick-action device, or give intimation that Mr. Westinghouse at the date of that patent knew of more than one form of

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R. H. WHITTLESEY,
Special Examiner.

7 NEW YORK, July 24, 1891.

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I now ask you if those parts which you have designated by numbers as referred to above, together with the valve 41, constitute the "auxiliary-valve device" named in claim 1 of the patent in suit?

A. I believe that the designation of the several passages, ports and chambers, as stated in the question, occurred in that portion of my deposition wherein I described the construction and operation of the preferred or illustrated form of the invention, that is, the form in which the patentee saw fit to adopt as one embodiment of his invention, so that it might be fully described.

I do not understand that the "auxiliary-valve device" of the said claim 1 of patent 360,070 is necessarily to be provided with all such ports, passages, &c., for upon turning to said claim it will be there seen that the only requirements in terms of the "auxiliary-valve device," are to be that it is to be independent of the main valve of the "triple valve," and is to be so actuated by the piston of the "triple valve," so that it will admit air in the application of the brake directly from the main air or train pipe to the brake-cylinder.

The preferred or illustrated form of the invention of the patent in suit has the several passages, ports and chambers named in the question, some of which are common to the passages and ports and chambers leading from the main air or train pipe to the auxiliary reservoir, and when a passage is open from the main air or train pipe to the auxiliary reservoir, main air or train pipe pressure would pass through the portions common to both passages.

From all of the above I think it will be manifest that all of the several parts forming the practically open passage from the main air or train pipe to the brake-cylinder which I designated by numbers when describing the illustrated or preferred form of the inven-

tion, are not necessary in order to constitute "the auxiliary-valve device" named in claim 1 of said patent 360,070, that is, while such parts may constitute one form of "the auxiliary-valve device" named in such claim, that they do not necessarily constitute the only form, and that "the auxiliary-valve device" named in said claim 1, may have a practically open passage from the main air or train pipe to the brake-cylinder, made up of any number of ports, passages and chambers that may be thought desirable by the constructor, so long as such "auxiliary-valve device" meets the requirements named in said claim 1, and so long as it does meet those requirements and performs the work in the combination of opening and closing or governing communication directly between the main air or train pipe and the brake-cylinder, so that the combination as a whole is substantially the same as it is now, then such an "auxiliary-valve device" would be the "auxiliary-valve device" named in said claim, no matter whether it had the specific form and arrangement of ports, passages and chambers or not, as the same are found in the preferred or illustrated form shown in the drawings.

X Int. 37. Does the specification describe or the drawings illustrate more than one passage for the admission of air directly from the drain-cup 19 to the brake-cylinder in making an emergency stop?

A. The drawings illustrate only one form of the invention, and the specification does not describe in detail but that one
119 form, which form I have heretofore termed the preferred or illustrated form, and as I have heretofore stated, such one form contains the several ports, passages and chambers referred to in the previous question.

X Int. 38. That one passage for the admission of air from the drain-cup 19 directly to the brake-cylinder in making an emergency stop, as described in the specification and illustrated in the drawing, consists of the port 42, chamber 43, passage 46, chamber 47, and passage 48; does it not?

And in answering this question, which refers only to what the specification describes and the drawings illustrate, please confine your answer to the question without going into long and irrelevant details and theories that are not asked of you.

A. The illustrated form of the passage and the one described in detail in the specification between the points named in the illustrated or preferred form is comprised of the parts named in the question, which are the same parts between the same points, which I named in my direct examination when describing such preferred or illustrated form, and will be found in the order named in X Int. 36.

X Int. 39. Does the specification anywhere describe or allude to any other passage for the admission of air directly from the drain-cup 19 to the brake-cylinder in making an emergency stop, than the passage designated by the figures 42, 43, 46, 47, 48?

If so where does it describe or allude to such other passage?

A. I have repeatedly stated that the specification describes but one form of the invention.

Defendants' counsel interrupts the witness to say that he is not asking about the invention, but about this particular air passage; and if it be possible for the witness to give a direct answer to a fair question, he requests him to do so.

Witness resumes: At this point I will say that I have
120 repeatedly answered the question, and I will again answer it, and that this preferred or illustrated form was shown and described in detail, and that it was the only form which was so shown and described, and in this form the passage was made up of the ports, passages and chambers as designated in the question.

If the term "allude" means an allusion to another specific form of passage, I would state that I do not find any such specific form alluded to; if, on the other hand, it means that there is anything alluded to in the specification that indicates there may be another form of passage, then I would say that I do not find in the specification such an allusion, and it will be found in my answer to X Int. 35.

X Int. 40. This passage 42, 43, 46, 47, 48, is not found in the mechanisms illustrated in the three letters patent Nos. 168,359, 172,064 and 220,556 referred to in the specification of the patent in suit, page 3, lines 42 and 43; is it?

A. The passage referred to in the question with an auxiliary valve or auxiliary-valve device, governing or controlling communication directly from the main air or train pipe to the brake-cylinder, is not found in either one of the patents referred to in the question.

X Int. 41. Question repeated and a categorical answer demanded.

A. In making my answer to the preceding question, I understood "this passage" of said question to be one which had like functions to the passage 42, 43, 46, 47, 48 of that question, and with the necessary appliances to perform such function, and that there might not be any mistake, I in substance stated my understanding of the passage in question and then fully answered the question. From the fact that the question is repeated I am led to believe that the question is intended to mean something else, and while such is the case, I am at loss to understand how it is possible to make a categorical answer. In my previous answer I simply adopted the form of the question in my answer in order that it might be thoroughly responsive, the form of the question being, "is not found," * * * "is it," and I answered, "is not found."

121 X Int. 42. Now, without further evasion, will you be good enough to answer X Int. 40 just as it stands?

A. I cannot answer the question more fully than I have already done, for the reasons stated in my answer to the previous question.

X Int. 43. My question, X Int. 40, names a specific passage and asks if you find that passage in any of the three prior patents referred to. Do you want the court to infer that you are mentally incapable of understanding so simple a question; or, on the other hand, that you do understand it and refuse to answer it?

A. I have not, as I am aware, refused to answer the question, but on the contrary have answered it fully, as will appear.

There is not the slightest hesitancy in answering the question to the fullest extent on my part, that I am aware of, and the only thing I want the court to understand is that I do not wish to have my answers quoted as meaning something entirely different from what I intended to say, and I believe that this much I am entitled to.

I do not understand now that there is any question but that I have fully answered X Int. 40, but it is simply a question of form only. If I have not answered it fully I am entirely willing to so answer it, as I have not the slightest desire to evade answering any definite question that may be propounded to me.

Recess until 2 o'clock p. m.

X Int. 44. I asked you whether a certain air passage which is marked 42, 43, 46, 47, 48 in the patent in suit, is to be found in any of the prior three patents named in my 40th X Int., to which you replied in substance that it was not to be found there performing the same functions or provided with an auxiliary valve to control it. It is perfectly clear that such an answer is not responsive to my question; and I again repeat the question and demand a responsive answer.

122 A. As I now understand the question it relates to the specific form of the passage, and with such understanding I would answer that it is not found in either one of the patents referred to in said X Int. 40.

X Int. 45. My question did *not* relate to the specific form of the passage, but to the *substance* of the passage. Do you find in any of said three patents *any* passage, of *any* form, leading from the drain-cup to the brake-cylinder and through which air passes directly from the train-pipe or drain-cup to the brake-cylinder in the act of making an emergency stop?

A. I understood when I answered the said X Int. 40, that it did relate to the substance and made my answer in the form that there could be no doubt about it, and I believe the answer was thoroughly responsive to the question.

When the question was repeated I could not but think that it related to something else or some other passage that did not have the function of the passage 42, 43, 46, 47, 48, in what has become known as "emergency stops," and therefore made my several answers as they appear.

I do not in any of said three patents find *any* passage of *any* form leading from the drain-cup to the brake-cylinder through which air passes "directly" from the train-pipe or drain-cup in the act of making what has become known as "emergency stops."

X Int. 46. That passage, with the auxiliary slide-valve 41 controlling it, constitutes substantially the mechanical instrumentality which Mr. Westinghouse added, in his patent No. 360,070, to his old automatic air-brake mechanism, or, in other words, constitutes the auxiliary-valve device of the patent No. 360,070—does it not?

A. The passage 42, 43, 46, 47, 48, with the auxiliary valve 41, controlling the same, constitutes the mechanical instrumentality which the patentee, Westinghouse, saw fit to adopt in illustrating and describing his invention in connection with the form of "triple valve"

123 which he also saw fit to adopt for the same purpose, and in one sense it may be said that he added such passage and auxiliary valve to his former triple valve as the same is shown in his prior patent 220,556, which, with other modifications in such triple valve, enabled him to illustrate his invention which required a different manipulation of the main air or train pipe pressure over that which was necessary with such old form of "triple valve," and thereby make possible the third class of work to which I have heretofore referred, and which is now known as "emergency stops," and when such invention is in the preferred or illustrated form, as shown in the drawing of patent 360,070, such passage and auxiliary valve would then constitute an auxiliary-valve device substantially identical with that of the patent in suit in its general characteristics.

It will be borne in mind that said patent in suit refers to more than one form of auxiliary-valve device as I have heretofore explained, and therefore the term, "the auxiliary valve device of the patent No. 360,070," is indefinite. If it means that such passage and auxiliary valve from the auxiliary-valve device of the preferred or illustrated form, then I would answer that such passage and auxiliary valve does constitute the auxiliary-valve device of such preferred form; but if, on the other hand, it is intended to mean that such passage and auxiliary valve constitutes the auxiliary-valve device of the claims in the sense that the form and arrangement are essential, then I should answer that such passage and auxiliary valve do not constitute the auxiliary-valve device of the patent in that sense.

If the question simply refers to the patent in a general way, without any reference whatever to the form or arrangement of such passage and auxiliary-valve device, except that the form and arrangement is such as will enable the passage and auxiliary valve to perform the function of admitting main air or train pipe pressure directly to the brake-cylinder in substantially the same way as set forth in said patent, then with such an understanding as to the meaning of the question, I would answer that such passage
124 and auxiliary valve do constitute the auxiliary-valve device of the patent No. 360,070.

X Int. 47. I consider it perfectly clear that the patent itself refers to only one form of auxiliary-valve device, to wit: the form described in the specification and illustrated in the drawings; but waiving further discussion of this matter, I now ask you whether, whatever may be the form of the auxiliary-valve device, the patent requires that the valve which performs the function of admitting air from the main pipe to the brake-cylinder is to be separate from that which effects the preliminary admission of auxiliary reservoir pressure to said cylinder?

A. I understand the question to refer to the auxiliary-valve de-

vice by means of which the direct admission of main air or train pipe pressure to the cylinder is controlled, and with such understanding, I do not understand that the patent requires that such auxiliary-valve device shall in all cases be separate from the one which effects the preliminary admission of auxiliary reservoir pressure to said cylinder. If by the term "separate" it is meant that such auxiliary valve is to be a separate and distinct piece of material, which is the meaning I understand the word "separate" to have in the present question.

To make my meaning plain, I will state that, as I understand the matter, the auxiliary valve by means of which main air or train pipe pressure is admitted directly to the brake-cylinder, and the valve by means of which the preliminary admission of auxiliary reservoir pressure to the brake-cylinder is controlled, may be one and the same piece of material, the only difference being a difference in extent of the opening or port by means of which the two functions are performed, or a difference in the location of the ports alone, so that the two movements of the piston of the "triple valve," to which I referred in my direct examination, is enabled to control or govern communication directly from the main air or train pipe to the brake-cylinder upon the second or further movement or traverse of such piston and the first or preliminary movement or traverse of such triple-valve piston, controls or governs communication between the auxiliary reservoir and the brake-cylinder.

125 X Int. 48. How, then, do you explain the language of claim 1, where it speaks of the auxiliary-valve device being actuated by the piston of the triple valve and *independent* of the main valve thereof; and what meaning do you give to the word "independent" in this connection?

A. The previous question was not limited to any particular claim, but included the patent as a whole, and I answered it with that understanding and without reference to all the limitations that would be found in all the claims of the patent, or in other words, I answered the question in the broad sense in which I think it would be naturally read.

In my direct examination wherein I set forth the essential devices, mechanisms or instrumentalities which go to make up the brake mechanism particularly pointed out in said claim 1, and the differences existing between the illustrated or preferred form of the patent in suit and the said "Exhibit Defendants' Quick-action Triple Valve," I fully pointed out the characteristics of each one of the essential devices, mechanisms or instrumentalities of the brake mechanism of the said claim 1, and I think I therein explained the language of said claim 1, which is referred to in the present question, but I will again state my understanding in regard to such language.

So far as the brake mechanism particularly pointed out in said claim 1 is concerned, the auxiliary-valve device of that claim is to be one adapted to open direct communication between the main air or train pipe and the brake cylinder, and which is independent of

the valve which performs the main or primary functions in applying and releasing the brakes, and is also adapted to be actuated in one direction by reason of contact or a connection between the piston of the triple valve and the auxiliary-valve device, and that,

126 to meet the above characteristics of such auxiliary-valve device of said claim 1, I used the term independent in the ordinary sense as I understand the same and as it is used when applied to the preferred form illustrated in the drawings of the patent in suit. That is, it was to be a separate piece of material from that of the valve which performed the main or primary functions in applying and releasing the brakes, and that the valve which performs such main or primary functions has a movement separate and distinct from the movement of the auxiliary-valve device; that is, that the two do not at all times move together.

It will be observed that the main valve or the valve which performs the main or primary functions in applying and releasing the brakes of the preferred or illustrated form shown in the drawings, under certain conditions moves with the auxiliary valve, or in other words, such auxiliary valve moves with such main valve during a portion of the movement of such main valve.

Therefore I do not understand that the term "independent," as found in said claim 1, can mean anything more than I have just set forth, and I give the term "independent" the above meaning in my direct examination and have understood it to be such since then, and also had this meaning in mind when I answered the previous question.

It will be observed that no such term or requirement is found in claim 2 of said patent 360,070, and I specially had in mind such claim 2 when answering the previous question.

As counsel has, off the record, expressed a desire that I extend my answer to claim 4, I will so extend it.

An inspection of such claim 4 will show that there is no requirement in terms in such claim, that the auxiliary valve of such claim shall be independent of the valve which performs the main or primary functions in applying and releasing the brakes, as is the case in the brake mechanism particularly pointed out in said claim 1.

I do not understand that the "triple-valve device" particularly pointed out in said claim 4 requires that the auxiliary valve 127 of such device must necessarily be independent or separate from the valve which performs the main or primary functions in applying and releasing the brakes.

X Int. 49. Then, if I understand you, claims 2 and 4 cover the combinations respectively referred to therein, whether the auxiliary valve be integral with or separate from the valve which effects the preliminary admission of reservoir pressure to the brake-cylinder; am I correct?

A. Yes; so far as that particular feature goes you are correct.

X Int. 50. In the Westinghouse automatic air-brake mechanisms in general use in this country from the year 1879 to the beginning of the year 1887, especially, for example, in the mechanism shown

in the patent of Mr. Westinghouse dated October 14, 1879, No. 220,556, how was the "emergency stop" effected?

A. I do not understand that what has become known as "emergency stops" in connection with "quick-action triple valve," or "automatic quick-action systems of brakes" was possible with the Westinghouse automatic system as it existed, and exemplified as referred to in the question.

Of course collisions and accidents were liable to occur in those days the same as they are now, and it was desirable then to avoid such accidents if possible by stopping the train in the shortest possible space and time regardless of all other considerations, but as before stated the quickest space of time and shortest distance in which the train could be stopped was by allowing a steady escape of fluid pressure from the main air or train pipe of the engine, which required an action of all the "triple valves" throughout the length of the train precisely the same as I have described in connection with the second class of work I have heretofore referred to when such "service stop" was made by a continuous reduction of main air or train pipe as I have heretofore explained and not by a series of "graduating applications."

Or in other words the Westinghouse automatic system of brakes which were supplied with "triple valves" like those shown and described in said patent No. 220,556, was capable of only performing the two first classes of work heretofore referred to by me, namely, that of "graduating" and "service stops;" the latter class of work then as now was performed either by a continuous escape of main air or train pipe pressure at the engine, or a series of "graduating applications" as desired, or dictated by the judgment of the engineer.

The above, of course, has reference to the manipulation of the brakes by the engineer on the locomotive or engine.

Adjourned to meet at same place on Saturday, July 25th, 1891, at 10 o'clock a. m.

R. A. WHITTLESEY,
Special Examiner.

NEW YORK, July 25th, 1891.

Met pursuant to adjournment.

Counsel present as at last meeting.

Cross-examination of HENRY F. NEWEURY resumed:

X Int. 51. Inasmuch as Mr. Westinghouse states, in substance, in the patent in suit, page 2, lines 37, &c., that the triple valve 10 accords substantially with that of his prior patent No. 220,556, we may take the triple valve of said prior patent No. 220,556 as fairly representative of the triple-valve devices employed by Mr. Westinghouse and his company in the interval between October, 1879, and March, 1887. Now, taking such triple valve as shown in said prior patent, did not said valve, in its preliminary backward movement to apply the brakes, admit auxiliary reservoir pressure to the brake-

cylinder and in its further or final backward movement again admit auxiliary reservoir pressure to the brake-cylinder?

129 A. In the "triple valve" shown and described in the said patent 220,556, there are two openings in the valve designated s^1 , s^2 , the latter being smaller than the former, but both of them are between the valve which opens the passage common to both of these openings and the brake-cylinder and these two openings s^2 , s^1 , are arranged in the line of the path of travel of the slide-valve in which they are placed, the distance between the two openings being less than the size of the port or passage with which they connect, but it is possible, upon a very slight reduction in main air or train pipe pressure in making a "graduating application," to bring the smaller opening s^2 in register with the port or passage C, when such port or passage C is closed or shut off from the port or passage E, by the movement of the slide-valve H, in which are arranged the openings s^1 , s^2 , so that auxiliary reservoir pressure can pass by the valve e^1 , also arranged in the slide-valve H, through the passage c , into the opening s^2 , and through it into the port or passage C, and thence to the brake-cylinder, and upon a correspondingly slight reduction—

Defendants' counsel interrupts the witness to state that his question inquires simply whether said triple valve in passing through its backward traverse preliminarily admitted reservoir air to the brake-cylinder, and then, in its further or final part of the traverse, again admitted reservoir air to the brake-cylinder. It either did or did not, and the question is fully answered by a direct affirmative or negative. It is a gross abuse of the witness' privilege and of counsel's rights for the witness to insist upon evading question after question and cumbering the record with tedious and tiresome discussion of details not asked about; and counsel again protests against this practice, which is apparently designed to render cross-examination useless.

Witness states that he has not any desire to evade the question and emphatically denies the assertions of counsel that the form of his answer is designed to render cross-examination useless.

the valve e closes the passage c in the slide-valve H, thereupon closing communication between the auxiliary reservoir and the brake-cylinder.

Upon a greater reduction of main air or train pipe pressure than the first, the triple-valve piston moves back to a greater distance and brings the passage s^1 , in register with the port or opening C, and admitting auxiliary reservoir pressure through and past the unseated valve e^1 , through the passage c , opening s^1 , and port or opening C, to the brake-cylinder.

Therefore, it is true, upon the movement of the piston G a certain distance, which may be termed its preliminary movement, auxiliary reservoir pressure is admitted to the brake-cylinder, and that, upon a further movement, auxiliary reservoir pressure is again admitted to the brake-cylinder, and, by reason of the fact that the

slide-valve H can bodily move past the port or opening C leading to the brake-cylinder, auxiliary reservoir pressure is also again admitted to the brake-cylinder in still larger volume than either of the other two admissions and without any control of this last-named admission by the valve e^1 in the slide-valve H.

Owing to the fact that three admissions of reservoir pressure would take place with the form of triple valve illustrated in said patent and the question referred to only two, I have answered the question as it appears.

X Int. 52. In the form shown in Fig. 1, of said patent No. 220,556, when, in the backward movement of the piston, to apply the brakes, the back end of the piston stem g rests against the graduating stem b^1 , without compressing the spring b^2 , which port of the triple valve is in communication with the passage or port C leading to the brake-cylinder?

A. As near as I can make out the opening s^1 would be in communication with the port or opening C leading to the brake-cylinder.

131 X Int. 53. In that position auxiliary reservoir air would pass through the port s^1 and the port or passage C to the brake-cylinder, would it not?

A. It would as I have already described.

X Int. 54. Now, assuming a further reduction of train-pipe pressure, sufficient to cause the piston G to move further backward to the extreme limit of its backward traverse, so as to compress the spring b^2 and rest against the packing A^2 , then, in that case, would the large port or passage C, which admits air from the reservoir to the brake-cylinder, be held open or closed?

A. The port or passage C would be open to its full extent, but would not be held open without a still further reduction in main air or train pipe pressure, owing to the fact that the expansion or escape of auxiliary or reservoir pressure into the brake-cylinder would reduce such pressure in the reservoir, and again close the port or opening C, by the forward movement of the piston G, and the valve H which is actuated by the piston, and this closure would take place in proportion to the equalization of pressures in the auxiliary reservoirs and main air or brake pipe, aided, of course, by the force exerted by the spring b^2 .

X Int. 55. In case the train should break in two or the train-pipe become ruptured, the piston G would become seated against the packing A^2 , opening the port or passage C wide open, and holding it wide open, and thereby applying and holding the brakes applied with the maximum force of which the auxiliary reservoir force is capable; would it not?

A. It would, because there would be a still further reduction of main air or reservoir pressure below the point necessary to bring the piston G in the position stated in the previous question, and I would state that I understand this to be the distinctive feature of the "automatic system of brakes" over and above what is known as "direct acting system of brakes," and is common to all "triple valves" adapted for use in the automatic system.

X Int. 56. So, also, if when running his train the engineer should discover imminent danger of collision or other accident
 132 ahead, his duty would be to so exhaust the train-pipe pressure as to bring the triple-valve piston G into contact with packing A², and open the port or passage C, so as to suddenly effect the application of the brakes with the maximum pressure available in the auxiliary reservoir; would it not?

A. It would be his duty in the case named in the question, as it would also be in the case he was tardy in commencing the application of the brakes in approaching a station, or at any times when — was not making “graduating applications,” to reduce main air or train pipe pressure, so that the pistons of each of the “triple valves” throughout the train would become seated and held against the packing A² of each one of such triple valves, but this could not be done suddenly in the sense in which we use that term in the “automatic quick-action system of brakes,” owing to the fact that fluid pressure or air in the main air or train pipe would have to travel from the rear end of the train to the engine before the last triple-valve piston would be affected.

It will be borne in mind that I have already explained that “service stops” or the second class of work to which I have heretofore referred, could be made in two ways: one by a continuous escape of fluid pressure at the engine, and the other by a series of “graduating applications,” and that under the circumstances stated in the question, the operation would be by a continuous escape of main air or train pipe pressure at the engine, and one of the ways in which such second class of work is performed, and no different under the circumstances named in the question than it would be under the condition named by me, that is, when the engineer was tardy in commencing the application of the brakes upon approaching a station, or did not wish to make the stop by a series of graduating applications.

X Int. 57. The brakes would be applied more quickly by full force by causing the piston G to move back and seat upon the packing A² than they would be applied by simply causing the stem g to
 133 move back and seat against the stem b¹ and thus merely put the port s¹ in communication with the port C, is not this the fact?

A. It is true that a continuous escape of main air or train pipe pressure will apply the brakes more quickly than is possible with a series of “graduating applications,” but in each case they can be applied with full force or the maximum force which the auxiliary reservoir pressure is capable of applying them; the only difference, as I understand, is the question of time of the two classes of stops.

X Int. 58. In figures 1 and 2 and 3 of patent No. 220,556 how is the main valve of the triple-valve device lettered or designated in the drawings?

Well, what do you mean by main valve; there is no such term in that patent, I believe?

Defendants' counsel replies that he leaves the witness to define the term as best he can.

A. The slide-valve, by means of which the port or opening leading from the valve chamber of the triple valve to the brake-cylinder is opened and closed to its fullest extent, and communication from the brake-cylinder to the atmosphere is closed, by means of which one form of service stop is made and the brakes in all cases are released, is lettered H, and so far as the functions of this slide-valve H and the small valve e^1 , which is of the puppet type and has its seat in the slide-valve H, are concerned, and without regard to any other construction than that shown in said patent 220,556, I should term this slide-valve the main one of the two. The puppet valve e^1 , which has its seat in the slide-valve H, is termed in the specification of said patent 220,556, an "auxiliary valve e^1 ."

X Int. 59. In claim 1 of said patent 220,556, the valve H is termed "the main valve," and the valve e^1 is termed "an auxiliary valve;" am I not correct?

A. I believe you are substantially correct, and in my hasty examination of the descriptive part of the specification I did not notice the claim; if I had, I should have stated the fact, or
134 at least not questioned counsel as to his meaning of the term "main valve." It will be observed that the slide-valve H, strictly speaking, is not termed the "main valve," although the term main valve is used in claim 1, and I understand such term to refer back to the valve H mentioned near the beginning of the claim.

X Int. 60. One of the functions of this main valve H, in the triple-valve device of patent No. 220,556, is the function of putting the port or passage C in communication with the auxiliary reservoir pressure when the triple-valve piston G compresses the spring b^2 , and seats upon the packing A^2 , is it not?

A. It is, as I have heretofore several times stated.

X Int. 61. In the backward movement of the triple-valve piston G, through its entire backward traverse, the puppet valve e^1 first unseats to effect a preliminary admission of reservoir air to the brake-cylinder, and then finally the main valve H puts the port or passage C again into communication with the auxiliary reservoir pressure; am I correct?

A. The brake-cylinder can only be put in communication with the auxiliary reservoir in all three cases heretofore named by and through the movement of the slide-valve H; simply unseating the puppet valve e^1 , does not admit auxiliary reservoir pressure to the brake-cylinder, which can only take place by the operation of the slide-valve H. It is true that upon the combined unseating of the puppet valve e^1 and the operation of the slide-valve H auxiliary reservoir pressure can be admitted to the brake-cylinder through the passage in the slide-valve H, which is controlled by the puppet valve e^1 , as when making "graduating applications," and also that when the piston G moves the slide-valve H, a still further distance in its backward movement, such valve H moves beyond the port

or passage C, and admits auxiliary reservoir pressure to the brake-cylinder.

But in each case it is necessary that the slide-valve II shall be operated, first, to close communication between the brake-cylinder and the atmosphere and then to admit auxiliary reservoir pressure to the brake-cylinder through either one of the openings or passages s^2, s^1 , and when the slide-valve II moves either partially or wholly from over the port or passage C.

X Int. 62. Then the main valve II assists in performing the function of preliminarily admitting the air from the reservoir to the brake-cylinder, upon the movement of the stem g , nearly into contact with the shoulder or enlarged portion of the stem b^1 (shown in said drawing figure 1, about half an inch below the stem g); but, by itself alone, and without the aid of the graduating valve e^1 , the main valve II performs the entire function of the second or final admission of air from the auxiliary reservoir to the brake-cylinder, when the piston G reaches or closely approximates the extreme backward limit of its traverse; am I correct?

A. As I understand the matter you are not.

X Int. 63. Explain why not?

A. The reason why you are not correct is this: That the operation so far as the two admissions of auxiliary reservoir pressure to the brake-cylinder are concerned, without regard to the stopping of such admissions, but considering them as they take place upon the backward movement of the piston, are precisely the same as they would be if the puppet valve e^1 was entirely removed from the structure, which in effect is done by continuously holding it unseated throughout the entire backward movement of the piston G after the stem of such piston engages with the slide-valve II, and the only office of the puppet valve e^1 is, as I understand the matter, to shut off or stop the admission of auxiliary reservoir pressure to the brake-cylinder, when a less amount than the maximum force with which such auxiliary reservoir pressure will apply the brakes is desired, and without requiring any movement of the slide-valve II, so that the piston G will be relieved from the friction of the slide-valve II, and thus be far more sensitive to slight reductions in auxiliary reservoir pressure, and therefore making it possible to admit smaller quantities of auxiliary reservoir pressure to the brake-cylinders at each time or application.

The puppet valve e^1 is used, as I understand the matter, in making what I have heretofore termed and has become known as "graduating application," and such puppet valve enables the engineer to "graduate" the force to a nicer or finer extent, which the auxiliary reservoir pressure admitted to the brake-cylinders, will exert in applying the brakes to the wheels of the train, than would be possible when the slide-valve II had to be moved, for the increased friction of the slide-valve II, and consequently the greater labor or work put upon the piston G, would require a greater reduction in auxiliary reservoir pressure, in order to move such valve at all, and when it is once started to move, such increased reduction would be liable to carry the piston G and slide-

valve H in a forward direction to an extent sufficiently to open communication between the brake-cylinder and the atmosphere, and thus release the brakes at the very time it was desired they should be applied to decrease the speed of the train or hold it in check upon a downgrade.

X Int. 64. To modify my last question a little: In effecting and controlling the preliminary flow of air from the auxiliary reservoir to the brake-cylinder, under the conditions stated in my last question, the main valve H and the auxiliary and graduating valve e^1 co-operate in the performance of said function, while in effecting and controlling the second or final flow of auxiliary air to the brake-cylinder, referred to in said question, the main valve H alone performs such function; am I not correct?

A. I understand that the function referred to as being performed by what counsel has termed "the preliminary flow of air from the auxiliary reservoir to the brake-cylinder," to be what is known as the function of "graduating," or the function performed in making "graduating applications," and with this understanding the auxiliary or graduating valve e^1 co-operates with the slide-valve H, and the two together perform such function, and it is the only function which I am aware of that the valve e^1 co-operates in performing, unless it can be said that it co-operates with the slide-valve H when it is absent from the structure entirely.

When the piston G moves backward with sufficient force to compress the spring b^2 , and cause the slide-valve H to pass entirely beyond the port or passage C, the slide-valve H moves quickly so that the openings s^1 , s^2 , in such slide-valve, quickly pass over and past the port or passage C, leading to the brake-cylinder, and consequently there is no appreciable time for the expansion or escape of auxiliary reservoir pressure to the brake-cylinder any more than there is from the time that the end of the slide-valve H begins to pass beyond the port or passage C leading to the brake-cylinder; therefore the preliminary flow of air from the auxiliary reservoir or flow of air from the auxiliary reservoir to the brake-cylinder can be said to take place during the entire time that the slide-valve H is moving in a backward direction upon a continuous escape of main air or train pipe pressure at the engine, and the final flow, that which takes place or the escape or expansion of auxiliary reservoir pressure into the brake-cylinder after the slide-valve H has entirely uncovered the port or passage C leading to the brake-cylinder.

If the question has to do only with the backward movement of the piston G and the slide-valve H, there is no co-operation between the valve e^1 and the slide-valve H, as I have heretofore explained, and the only controlling of any flow of air from the auxiliary reservoir to the brake-cylinder or escape or expansion of auxiliary reservoir pressure to such cylinder that takes place by means of the valve e^1 is upon making a "graduating application," as I have heretofore explained: therefore, if there is to be any control by the valve e^1 , it must necessarily be upon making a "graduating application, and any 'preliminary' flow of air from the auxiliary reser-

voir to the brake-cylinder," which is controlled by the said valve e^1 , must necessarily be the flow which takes place when making a "graduating application" and not when the slide-valve H and piston G move backward to their extreme limit of their movement in that direction.

138 In making a "service stop" by a continuous escape of main air or train pipe pressure, so that the slide-valve H and piston G move backward sufficiently to wholly uncover the port or passage C leading to the brake-cylinder and hold the piston G in contact with the packing A^2 , is to be considered "the second or final flow of auxiliary air to the brake-cylinder;" then the slide-valve H alone may be said to control such second or final flow, and for the reason stated above in connection with what counsel has termed "the preliminary flow of air from the auxiliary reservoir to the brake-cylinder."

If this so-called "second or final flow of auxiliary air to the brake-cylinder" is to be understood as that portion of the flow or escape or expansion of auxiliary reservoir pressure to the brake-cylinder which takes place through the port or passage C after the slide-valve H has moved backward to the extent of the limit of its movement in that direction, and it is held there until the brakes are applied with the maximum force with which the auxiliary reservoir pressure can apply them, then the slide-valve H only permits such escape or expansion of auxiliary reservoir pressure, and in no way controls it, and the amount of such pressure which does escape or expand into the brake-cylinder is determined and controlled by the amount of such pressure originally in the auxiliary reservoir, or, in other words, the escape or expansion of auxiliary reservoir pressure into the brake-cylinder ceases upon an equilibrium being established between the pressure in the brake-cylinder and the auxiliary reservoir, regardless of the slide-valve H.

From the above it will appear that you are not correct in both assumptions of the question upon either understanding as to the meaning of controlling "the preliminary flow of air from the auxiliary reservoir to the brake-cylinder," and also "controlling the second or final flow of auxiliary air to the brake-cylinder."

Under one understanding—that is, that the so called "preliminary flow" is the flow which takes place in making a
139 "graduating application" and that the "second or final flow" is the one which takes place upon the piston G moving backward to the extreme limit of its movement in that direction and held against the packing A^2 —it will be manifest that the slide-valve H and the valve e^1 co-operate in effecting and controlling the "graduating application," and it is also manifest that the slide-valve permits or effects the escape or expansion of auxiliary reservoir pressure to the brake-cylinder, but that it does not in any way control such escape or expansion.

Under the second understanding—that the so-called preliminary flow is that which takes place during the backward movement of the slide-valve H, or any portion of it, upon a continuous reduction of main air or train pipe pressure, which will cause piston G to

move backward to its extreme limit in that direction, and that the so-called "second or final flow" or expansion or escape of auxiliary reservoir pressure which takes place after the port or passage C is entirely uncovered or opened—then it is not true that the slide-valve II controls such so-called "second or final flow," but only permits it, and in that sense effects such flow, escape, or expansion of auxiliary reservoir pressure to the brake-cylinder.

If, on the other hand, this so-called "second or final flow" or escape or expansion of auxiliary reservoir pressure to the brake-cylinder is to be considered that portion, which is substantially all which enters the brake-cylinder through the port or passage C from the time that the end of the slide-valve II begins to pass beyond and uncover or open the port or passage C, then the only control that the said valve II has over such flow, escape or expansion is that which it exercises before the port or passage C is entirely opened or uncovered by the backward movement of such valve II, but even considering such so-called "second or final flow" with this understanding, and that such flow is controlled and effected by the slide-valve alone, it would still be true that there would be no control by the valve *e'* upon the so-called "preliminary flow" upon the backward movement of the slide-valve II to its extreme limit in that direction, and therefore under any understanding I at the present time have of the question you would be incorrect, and for the reasons above set forth.

X Int. 65. In making a graduating application the piston G is moved backward till the end of its stem *g* rests against the stem *b'*, which takes place when said piston has completed about one-half of its entire range of backward movement; am I correct?

A. Not entirely. A graduating application can be made that way, and it also can be made either before the piston has reached the position named in the question or has passed way beyond it.

X Int. 66. It is ordinarily made as I have described it, is it not?

A. That depends upon what is meant by ordinarily. I believe that that is the easiest and most certain way of making a "graduating application," and if "ordinarily" means this, then I should answer, yes.

X Int. 67. If, while making a graduating application in the manner described in my 65th X Int., the engineer should discover impending danger close ahead which the small graduating pressure that he had already applied to the brakes would be insufficient to avoid, his duty would be to further reduce his train-pipe pressure as quickly as possible so as to bring the piston G against the packing *A*², and open the port C wide open; would it not?

A. If the engineer, while making a graduating application in any manner possible with a triple valve like that shown and described in said patent 220,556, should discover impending danger close ahead, it would be his duty to continue such "graduating application" into a continuous reduction of main air or train pipe pressure until each and every triple-valve piston G in the train had become seated against its packing *A*² and held there

until an equilibrium in pressure was established in each individual auxiliary reservoir and its corresponding brake-cylinder, and thus change his "graduating application" into a "service stop" made

by a continuous reduction of main air or train pipe pressure.

141 I do not understand that with "the automatic system of brakes" as it existed when triple valves like said patent 220,556 were used, that there was any difference whatever in the suddenness or quickness with which main air or train pipe pressure was reduced in making a "graduating application," or a "service stop," by a continuous reduction in main air or train pipe pressure, except in the difference in time which the engineer left his operating cock or valve open to the atmosphere for the escape of such main air or train pipe pressure. And also that the only difference between a "service stop" made by a series of "graduating applications" and one made by a continuous reduction in main air or train pipe pressure, when such "graduating applications" are made by the backward movement of the piston G until it comes in contact with the stem *b'*, except from the time elapsing between each graduating application and the next one of the series, occurs from the difference in the capacity of the graduating passage, and that of the port or passage C leading to the brake-cylinder.

If the question by—

Defendants' counsel interrupts the witness to again protest against this inexcusable waste of time.

The witness states that owing to the indefiniteness of the question, he was going to continue his answer under what he thought barely possible might be the meaning of the question, but will desist in deference to counsel's statement just made.

X Int. 68. In making a graduating application the valve *e'* is moved backward in the passage *c*, which, in connection with the port *s'*, extends through the main valve H, is it not?

A. It is during a portion of making such graduating application.

X Int. 69. That movement is necessary in order to permit
142 air from the auxiliary reservoir to pass through the main valve H, when the passage in the latter shall come into communication with port C, is it not?

A. Yes; I understand the term "air" to be compressed air or pressure in the reservoir above that in the brake-cylinder.

X Int. 70. And when the valve *e'* moves forward again it closes the passage through the main valve H, and thus stops the escape of air pressure from the auxiliary reservoir to the brake-cylinder, does it not?

A. It does, as I have heretofore explained.

Adjourned to meet at same place on Monday, July 27th, 1891, at 10.45 o'clock a. m.

R. H. WHITTLESEY,
Special Examiner.

NEW YORK, July 27th, 1891.

Met pursuant to adjournment.
Counsel present as at last meeting.

Cross-examination of the witness HENRY F. NEWBURY resumed :

X Int. 71. Before resuming the subject-matter under inquiry Saturday afternoon last, I desire briefly to digress to another matter.

There are two equity suits Nos. 4976 and 4977 pending in the circuit court of the United States for the southern district of New York. In No. 4976, the Westinghouse Air Brake Company sues the New York Air Brake Company *et als.* for alleged infringement, among other things, of the patent of Harvey S. Park, dated December 4th, 1888, No. 393,784, relating to improvements in quick-action automatic air-brake systems.

In suit No. 4977, George Westinghouse, Jr., and the Westinghouse Air Brake Company, as joint complainants, sue the New York
143 Air Brake Company *et als.* for alleged infringement, among other things, of the patent of George Westinghouse, Jr., dated January 24th, 1888, No. 376,837, relating also to improvements in quick-action automatic air-brake systems.

In both of said suits, one Henry F. Newbury was called and examined, and testified as an expert for the complainants. Are you the Mr. Newbury who testified in those suits as expert for complainants?

Objected to as not proper cross-examination, the matter inquired about not having formed any part of the witness' deposition-in-chief.

A. I did testify in two cases, which I believe to be the ones referred to in the question.

X Int. 72. In the case which involved the alleged infringement of the said Park patent, I find from the printed proof-sheets of your testimony therein, which I hold in my hand, that the 17th and 18th X Ints. and answers in your deposition were as follows, to wit :

" 17 X Q. You admit, do you not, that the invention described in the Park patent 393,784 is either an improvement upon the inventions described in patents 360,070 and 376,837, or else a different apparatus from, whether better or worse than, the apparatus described in those two patents for accomplishing the same final result, namely, opening the valve which controls communication between the brake-pipe and brake-cylinder?

"A. As I understand the matter, said patent 393,784 is for an invention which is tributary to patent 376,837 and may be said to be an improvement upon the invention of the last-named patent, or it may be for an invention for accomplishing the same result, but with a somewhat different arrangement of parts. Whichever it is, it is for the court to say.

"I do not understand that the invention of said Park patent is tributary to patent 360,070, and so far as that patent
144 alone is concerned, the invention of patent 393,784 may be

said to be for a different combination of devices or elements by means of which the same final result, namely, a quick-action automatic system of brakes, is provided.

"18 X Q. In your answer you seem to think that you ought to construe the three patents named. My question did not relate at all to the breadth or scope of either of the patents, so I will repeat it in substance, changing its form.

"Will you not admit that the invention described in the Park patent and the inventions described in patents 360,070 and 376,837 are for the purpose of accomplishing the same result, namely, the operation and control of a valve which controls communication between a brake-pipe and brake-cylinder?"

"A. The mechanisms or combinations of devices shown and described in the several patents named in the question are designed to accomplish one general object, namely, that of providing a quick-action automatic system of brakes."

In the other suit, which involved the alleged infringement of the Westinghouse patent, dated January 24, 1888, No. 376,837, I find from such printed proof-sheets now in my hands that cross-questions and answers 20 and 21 of your said deposition in such suit were as follows, to wit:

"20 X Q. Which of the three patents, 360,070, 376,837 and 393,784, do you regard as the pioneer or bottom patent so far as relates to quick-action triple valves?"

"A. So far as regards the two first mentioned, I do not regard one as being the pioneer over the other so far as one controls the other, but it is a fact that patent 360,070 was granted at an earlier date than that of 376,837, and, as I have heretofore stated, I would rank them side by side and of equal importance so far as regards a quick-action automatic system of brakes.

145 "21 X Q. Don't you think it fairer, on the whole, to regard all three as of equal rank, but the first as the pioneer so far as regards controlling the valve which controls communications between the brake-pipe and the brake-cylinder by means of the triple-valve piston; the second as the pioneer so far as concerns controlling that valve by means of the triple valve itself, and the third as the pioneer so far as regards controlling that valve by means of an independent valve actuated by the triple-valve piston?"

"A. No; I do not think that I can so regard them, because, as I look at the matter, I should regard the first as being the pioneer so far as regards the operation of the valve which controls communication between the brake or train pipe and the brake-cylinder, by means of the triple-valve piston acting mechanically upon it; and the second as the pioneer so far as regards the operation of such valve by auxiliary reservoir pressure acting independently of the triple-valve piston, and that these two are of equal importance; while the third I would regard as the pioneer in its distinctive feature, that is, that the valve which controls the communication between the brake or train pipe and the brake-cylinder is to be operated directly by brake or train pipe pressure instead of by aux-

iliary reservoir pressure; and this last was not of equal importance with the other two, so far as regards the art of quick-action automatic brakes."

These quotations from the proof-sheets of your depositions in said suits, correctly state the respective questions and answers in your testimony therein which they purport to state, do they not?

Same objection, and further objected to as irrelevant, immaterial and incompetent, it not being shown that the lengthy quotations of the question are copies or true copies of portions of the
146 witness' depositions in the suits referred to or in any other suits.

A. It is some time since I closed my depositions in the two cases referred to, and I have been engaged in testifying in quite a number of suits since that time, and at this time I would not attempt to testify as to the correctness of statements made upon proof-sheets from memory alone, for it is impossible for any person to carry details of depositions and be able to say whether anything, which purported to be a copy of the same, was correct or not, and for the above reasons I cannot state from memory alone whether the quotations made in the present question "correctly state the respective questions and answers" or not.

X Int. 73. Have you any reasonable doubt that the quotations contained in my last interrogatory are, in all substantial and material respects, correct copies of the respective questions and answers of which they purport to be copies?

Same objection, which, with protest against the improper consumption of complainants' time, is continued without further notice to this entire line of cross-examination.

A. I cannot state, for the reasons heretofore given, whether I have or have not any reasonable doubts upon the subject, and I have not given the matter sufficient attention or charged my memory sufficiently with the details of depositions after they are finished to be able to certify to the correctness of any alleged copy.

X Int. 74. In taking said depositions the examining counsel appear from the proof-sheets to have been Mr. J. Snowden Bell, for the complainants, and Mr. J. E. Maynadier, for the defendants; this is correct, is it not?

A. I believe it is.

X Int. 75. Your deposition in case 4976 appears to have begun on May 4, 1891, and concluded on May 7, 1891; and your
147 deposition in case 4977 appears to have begun on April 30, 1891, and to have continued, with various adjournments, till a date as late, at least, as May 20th, 1891; that interval between April 30th and the latter part of May, 1891, is about the time when you gave your testimony in the said cases, is it not?

A. I believe the two depositions were given somewhere about the times named in the question, but am under the impression that they closed earlier than the date named.

X Int. 76. In said depositions were you not asked by Mr. May-

nadier questions substantially such as I have quoted in my 72d X Int. this morning, and is not the substance of your reply to those questions correctly stated in the answers which I have quoted purporting to be your answers to such questions?

A. I recollect that Mr. Maynadier asked some questions of somewhat of the import or nature of those named in said cross-interrogatory, and while I cannot say that the alleged answers so quoted are substantially correct, I believe that I replied in the general manner therein stated.

X Int. 77. Resuming now the subject of our discussion when I interrupted it this morning, I will ask your attention to the quick-action automatic brake mechanism illustrated in plate XI of the Boyden 1891 catalogue, about which you testified in your examination-in-chief. Referring to this plate XI and the reference letters marked thereon, I understood you to say in substance in your examination-in-chief that the check-valve 26 performed the function of admitting train-pipe pressure to the auxiliary reservoir for the purpose of supplying the latter with compressed air, and that in respect to the performance of such function it was the practical equivalent of the ordinary feed-groove employed for many years past by Mr. Westinghouse to perform such function; or in substance, that the triple-valve piston provided with a passage through it and a check-valve to control the passage as shown in said plate XI is, for the purpose of feeding train-pipe air to the auxiliary
118 reservoir, the practical equivalent of the ordinary Westinghouse triple-valve piston acting in connection with such feed-groove.

Do I understand your position correctly with respect to such matter?

A. If it had been added when considering claims 1, 2 and 4 of said patent 360,070, and the substantial identity of said defendants' quick-action triple valve, as the same is illustrated in said plate XI, with the combinations and devices particularly pointed out in said claims, I should answer that for such purpose you did understand my position correctly.

X Int. 78. Now, if we should take the apparatus of said plate XI, fasten the check-valve 26 fast to the hollow stem surrounding the opening F and integral with the triple-valve piston, so that the check-valve could under no circumstances lift from its seat, and then provide the triple-valve piston with a feeding groove like that marked 51 in the drawings of patent No. 360,070 here in suit, then the apparatus of plate XI of the Boyden 1891 catalogue would cease to act as a quick-action automatic brake apparatus, would it not?

A. I believe that it would.

X Int. 79. So modified, the triple valve of the triple-valve apparatus or mechanism shown in said plate XI would act substantially like the triple valve of the triple valve or mechanism shown in figures 1 and 4 of the patent of Westinghouse No. 220,556, dated October 14th, 1879; would it not?

A. That would depend entirely upon what meaning was given

to the term "substantially" in the question. If such term "substantially" is understood as meaning that the so-modified Boyden triple valve would perform the two classes of work heretofore referred to by me, namely, making "graduating applications" and "service stops," I should answer that it would act in "substantially the same manner as the said triple valve of the said patent 220,556 the same as with all other forms of "triple valve" which, I believe preceded the date of the invention of the patent No. 360,071.

149 If the term "substantially" is to have a more limited meaning, then I should answer that it would not, as will be manifest upon an inspection of the so "modified Boyden triple valve," and the "triple valve" of the said patent 220,556.

The "triple valve" of the patent 220,556 is capable of admitting auxiliary reservoir pressure to the triple-valve chamber in large quantities or volume than can be carried from such valve chamber to the brake-cylinder, so that when the triple-valve piston, designated in said patent as G, is seated upon the packing A², the port or passage leading from such valve chamber to the brake-cylinder and which is designated in said patent as C, cannot allow auxiliary reservoir pressure to escape from such valve chamber any faster, or in fact not as fast, as such pressure enters such chamber, and from which it results that the slide-valve H and the port or passage C control the amount of auxiliary reservoir pressure which can pass at one time into the brake-cylinder, while this is not the fact with the "modified Boyden triple valve," and for manifest reasons.

There are other differences which I could point out when the term "substantially" is given the limited meaning which I have just above indicated, but will not at the present time consume the time necessary to do it.

X Int. 80. Assume that the Boyden valve device, modified as stated in X Int. 78, has its passage B of the same capacity as the passage C of patent 220,556; then, in such case, would not the triple-valve device of plate XI, so modified, act practically in the same manner and with the same effect as the triple-valve device shown in said figures 1 and 4 of patent No. 220,556; and if not, why not?

A. The present question is indefinite in substantially the same respect as the previous one, the term "practically" being substituted for "substantially," and when that indefiniteness is cured as in the answer to the previous question, then such answer would apply to the present question, as well as the reason therein given.

150 There is another matter of indefiniteness which has to do especially with the present question, although, in a measure, it applies to the previous one, and that is, when dealing with fluid pressures which exert different degrees of force according to the difference in the pressures, the slightest difference in openings or ports through which one pressure expands or escapes from one point of confinement to another is of great importance when considering what the pressure shall be at various points of confinement, and what the operative effect of such pressures may or will be, cannot be determined with any definiteness without all these

differences of ports, openings or passages being clearly defined in the structure under consideration.

The question has to deal with mere pictures, which do not even purport to represent the same construction, and also which do not purport to bear any relation whatever to one another—so far as sizes and proportions of the several parts of each are concerned.

From the above it will be manifest that the further modification of the present question over that of the one which preceded it is not one which would give any definite idea of what the modified construction would be.

I assumed that the largest one of the two openings C, one being shown in Fig. 1 and the other in Fig. 4 of the printed Patent Office copy of said patent 220,556, was the one referred to by counsel as the size of said passage which was to take the place of the one designated as B of the "modified Boyden triple valve" when I made up my answer to the present question from that of the previous one.

X Int. 81. Take the apparatus shown in plate XI of Boyden 1891 catalogue here in evidence, fasten the check-valve 26 to its seat so that it cannot separate therefrom, provide the apparatus with the feeding groove exactly like that marked 51 in patent 360,070, and make the passage B of the same capacity as the passage C of patent 220,556—and I don't care whether you assume the passage to be

of the size shown in Fig. 1 or of the size shown in Fig. 4 of said patent 220,556, for I regard that as entirely immaterial—

and then tell me if you understand this modified construction or understand what the Boyden structure would be as thus modified?

A. Of course, I have an idea of what the structure might be, but for the reasons heretofore given it is manifest that quite a number of structures could be constructed, from the description given, and have no two of them alike. What I might construct might differ from what counsel has in mind, and also from what several other persons might construct from the same instructions; and, therefore, if any two of them were alike it would be pure accident and not what the instructions contained.

Of course all of the several structures would probably perform the two first classes of work—

Counsel for defendant-interrupts the witness to say that he is not asking about that, but whether he understands the modification as suggested—if the witness will answer the question as a witness, and not assume to act both as complainants' counsel and witness we should get along much faster and get something done.

to which I have heretofore referred and in this sense only they might be said to be *the* structure of the question, and in this sense only do I understand *the* structure of the question.

Of course I have an understanding of *a* construction, but whether it is *the* construction of the question I have no means of determining from the question itself.

X Int. 82. I assume all the parts shown in Fig. XI to be entirely unchanged except in the three particulars named in my question.

I assume the feed-groove to be precisely like that shown and marked 51 in the drawings of the patent in suit No. 360,070. I assume the passage B to be precisely the same as the passage B of plate XI of the Boyden 1891 catalogue, except that it is made of the same capacity for transmitting air pressure as the passage of patent No. 220,556. I assume the cheek-valve 26 of plate XI aforesaid to be simply fastened to its seat so as to be incapable of moving therefrom—how fastened is utterly immaterial—but to prevent a long answer, I will further assume that it is fastened by brazing it to the metallic part of its seat. Now, as thus modified do you understand the construction that I refer to—I mean, do you know what it is?

A. Not a single fact stated in the present question which is contained in the previous ones did I have in mind when I made my answer to the last preceding question.

I assumed that when—

Defendants' counsel interrupts the witness to request him to answer the present question.

Witness states that he is making his best endeavors to do so, but owing to the indefinite character of the question he is compelled to state certain facts so that his answer will not be misunderstood.

Counsel replies that the question is simply whether the witness does or does not know what the mechanical structure referred to in the question would be, and this question can be answered by yes or no, for he either does or does not know what the structure would be. Counsel is not asking in this question about its operation but simply what it is.

considering what counsel meant when he referred to "the drawing of the patent in suit No. 360,070" and the "passage C of patent No. 220,556," that he referred to the drawings of printed Patent Office copies of the patent in suit and also the same as regards patent 220,556, and so stated in one of my previous answers, and I will now state that I have no remembrance of ever seeing the actual patent in suit No. 360,070, nor the patent 220,556, and when 153 counsel has been formulating his questions he has held in his hand printed Patent Office copies of those patents.

To say the least, the present question is as indefinite as the preceding one, and, as I have before stated, I understand *a* construction or *a* mechanical structure which would meet all the terms of the question, but for the reason above stated I do not understand what *the* structure or *the* mechanical structure is.

X Int. 83. Do you understand the "structure" or the "mechanical structure," shown in figures 1 and 4 of patent 220,556, or is there some mysterious indefiniteness about this question, also, that only enables you to understand *a* structure, without being sure about *the* structure?

A. The "structure" shown in figures 1 and 4 of patent 220,556 is fully described in the specification, but as I remember said specification there is no statement as to the size or scale to which it is to be built, nor in fact do I remember any statement that the several

parts shown in those figures are to be constructed upon the scale therein shown, and as I understand the matter that any structure which formed the work—

Defendants' counsel interrupts the witness again to state that he has not asked him a question of law, nor what work any structure would perform, but simply whether the witness understands the construction of the structure shown in figures 1 and 4 of patent 220,556.

He will feel under great obligations if the witness will for this once at least confine his answer to the question that is asked him.

Witness considers that he is and has been complying with the above request.

that that structure will perform by means of the several devices combined, as there shown and described, is *the* structure of that patent, and this he believes he fully understands, but if the question intends to ask as to the actual dimensions which any one part

of the structure is to be, then I would answer that I do not
154 understand "the structure," or "the mechanical structure" in that sense, for as I understand it, the dimensions may be whatever the constructor may see fit to make them.

X Int. 84. I will assume that you understand the Boyden structure as modified in my 81st and 82d X Int., and that you understand the structure shown in patent No. 220,556, although it seems impossible to get you to say whether you do or not. Assuming that you do, I now ask you whether, in your opinion, the Boyden structure so modified is or is not the mechanical equivalent of the structure shown in patent 220,556 for the purposes of an automatic air-brake mechanism.

I call your attention to the fact that this question is a plain, simple question which can be answered affirmatively or negatively.

A. Understanding the term automatic air-brake mechanism as the same existed, that is, one which performs the first two classes of work to which I have heretofore referred, and considering the question broadly without special reference to the claim of said patent 220,556, I should answer Yes.

X Int. 85. In this question and the questions following, until I notify you to the contrary, I shall assume a Boyden structure modified as stated in my 81st and 82d X interrogatories, and place it in comparison with the structure shown in patent No. 220,556.

You have stated in substance heretofore in this examination that in applying the brakes for ordinary service stops or graduating applications, the valve *e*¹ of patent 220,556 first opens a passage through the main valve H, before the triple-valve piston G seats upon the packing A², and that when said piston seats upon said packing it opens the passage C, wide open, thereby admitting a fuller and freer flow of air from the auxiliary reservoir to the brake-cylinder.

Now, referring to the modified Boyden structure assumed in my question, in applying the brakes for an ordinary service stop or

graduating application, does not the stem 18, shown in plate XI of the Boyden 1891 catalogue, first move backward, just as the

155 Westinghouse valve *c*¹ moves backward under the same conditions, so as to admit air from the auxiliary reservoir to flow to the brake-cylinder, through a small port or passage, before the triple-valve piston 29 seats against the packing or washer marked 7; and when said piston seats against said packing 7, does not the valve marked 22 unseat, and admit a fuller and freer passage of air from the auxiliary reservoir to the brake-cylinder? I understand, of course, that the valve 22 of Boyden is not obliged to move in order to allow the passage through the stem 18 to open, while the main valve H, of patent 220,556, *is* obliged to change its position slightly in order to let air through the port opened by the back movement of the small valve *c*¹?

A. In the first place, the question seems to contain a statement somewhat at variance from anything which I have a recollection of saying, as I do not remember of stating, in substance, any such operation as is implied in this statement.

In my description of the operation of the "triple valve" set forth in said patent 220,556, I stated that the most convenient and certain way of performing or making a "graduating application" was to reduce the main air or train pipe pressure to a point sufficient to cause the piston G, with its stem *g*, to come in contact with the stem *b*¹, and in that sense, that was the ordinary way of making a "graduating application." I also stated, as I remember it, that a "service stop" could be made by a series of "graduating applications," and also that a "service stop" was made by a continuous escape and reduction of main air or train pipe pressure, which would cause the piston G to become seated against the packing A², and that when a "service stop" was made in this way, there was but very little or any expansion or escape of auxiliary reservoir pressure into the brake-cylinder through the opening in the slide-valve H made by the unseating of the valve *c*¹, as the slide-valve H was moving across the port or opening C.

I believe I also stated that it was possible to make a "graduating application" by the piston G extending beyond the point
156 where its stem *g* comes in contact with the stem *b*¹, but I have no recollection of stating that a "graduating application" was made by causing the piston G to move backward far enough to become seated against the packing A².

If I have stated anything farther than this I request counsel to point it out to me.

Defendants' counsel states that to avoid an answer several hours long he will put another question to the witness.

X Int. 86. Assume a train of two cars and an engine, one car having a triple-valve device of patent 220,556, the other car having the modified Boyden triple-valve apparatus indicated in my X Int. 81 and 82, and the train having the ordinary brake-cylinders, auxiliary reservoirs, main reservoir, brake-pipe, and other apparatus for supplying air and enabling the engineer to reduce the train-pipe

pressure at will. Now, with such a train, assume that the engineer reduces the train-pipe pressure sufficiently to cause the piston G of the Westinghouse device and the piston 29 of the Boyden device to seat against their respective packings A² and 7. When so seated, will not the main valve H, of the Westinghouse device, open the passage C wide open, and will not the large valve 22, of the Boyden device, open its port to an ample capacity, and will not the auxiliary reservoir air, in both devices, then flow freely and rapidly to the brake-cylinders, both of which will at the time be closed against the escape of said air to the atmosphere?

A. Upon the occurrence, stated in the question, the slide-valve H of the Westinghouse device will open the passage C wide open, as I have several times heretofore stated, and with the modified Boyden triple valve, as I understand the construction of the same to be, upon a like occurrence as stated in the question, the large valve 22 of such modified construction will open its port or passage to an ample capacity, and the auxiliary reservoir pressure or air of both triple valves will then flow freely and rapidly to their corresponding brake-cylinders.

157 X Int. 87. Then, so far as opening an ample flow from the auxiliary reservoir to the brake-cylinder when the triple piston is at the extreme backward limit of its traverse is concerned, and, in respect to this one function, the valve 22 of the modified Boyden device is the mechanical equivalent of the main valve H of the Westinghouse patent No. 220,556: is it not?

A. Without reference to anything else, but simply permitting a free flow of auxiliary reservoir pressure or air to the brake-cylinder, it may, thus broadly considered, be said that the said valve 22 of such modified Boyden triple valve, as I understand the same to be, is the mechanical equivalent of the slide-valve H of patent 220,556.

X Int. 88. Assume the same train referred to in my X Int. 86, and assume that the engineer desires to make a graduating application by a series of movements of the graduating valve. In such case, both pistons, G and 29, would move part way back, far enough to allow air to flow from the auxiliary reservoirs to the brake-cylinders through the respective small passages, to wit: the small passage c, s', through the main valve of the Westinghouse device, and the small holes and their connecting passage in the stem 18 of the modified Boyden device, and the main valve H of the Westinghouse device would not pass wholly by and uncover the passage C, and the large valve 22 of the Boyden device would not unseat and open its ample port; am I not correct?

A. I believe that you are.

X Int. 89. In making a graduating application in the manner aforesaid, the auxiliary reservoir air passes through the main valve H of the Westinghouse device, and, in the Boyden modified device, the auxiliary reservoir air passes through the large valve 22. Is not this the fact?

A. I believe that it is.

Adjourned to meet at same place tomorrow, Tuesday, July 28th, 1891, at 10 o'clock a. m.

R. H. WHITTLESEY,
Special Examiner.

158

JULY 28, 1891.

Met pursuant to adjournment.
Present: Counsel as before.

Cross-examination of the witness, HENRY F. NEWBURY, continued:

X Int. 90. Still referring to the supposed train of an engine and two cars, one car equipped with the triple-valve apparatus of the Westinghouse patent No. 220,556, and the other equipped with the modified Boyden apparatus, suppose, now, we plug up the passage *c, s'* of the Westinghouse valve, and also plug up the small holes or their connecting passage in the stem 18 of the modified Boyden apparatus. Then, will not the operation of said two triple valves be substantially as follows:

The Westinghouse valve, in making a service stop, will effect it by means of the main valve H uncovering in whole or in part the port or passage C; the modified Boyden apparatus, in making a service stop, will effect it by means of the large valve 22 opening more or less the port connected with it; if either valve is capable, when said small holes are thus plugged up, of making a graduating application, then the Westinghouse valve will effect such application by means of its large valve H, and the modified Boyden apparatus will effect such application by means of its large valve 22. I do not ask how said valves, as thus modified, will perform their other functions, but simply with reference to their performance of these two functions of making a graduating application and a service stop. Is not my statement of their operations, respectively, correct?

A. I believe it is.

X Int. 91. One question more with regard to the modified Boyden triple valve, with the small holes in stem 18 assumed to be plugged; would not the operation of such modified triple valve, with its small holes so plugged, be substantially the same as that of the triple valve shown in the patent of Geo. Westinghouse, Jr., dated January 11, 1876, No. 172,064—I mean the operation of the two triple valves assumed in the question, with respect to the application of the brakes, and the way in which the triple valve effects such application?

A. If the question has to do broadly or simply with the fact that the brakes in both cases can be applied, and without reference to the means, I should answer yes.

X Int. 92. I mean substantially this: In the application of the brakes by said two assumed devices respectively, would not that function, which, in the device of the Westinghouse patent No. 172,064, is performed by the slide-valve H, to wit, the function of admitting air from the auxiliary reservoir to the brake-cylinder to

set the brakes, be performed, in the supposed modified Boyden triple valve, by the action of the large valve 22?

A. So far as concerns simply the admission of auxiliary reservoir pressure to the brake-cylinder, without regard to holding it there so as to apply the brakes, then I should answer yes.

X Int. 93. And, in the modified Boyden apparatus, further modified as assumed in my few last preceding questions of this morning, the large valve 22, which would perform the function of admitting air from the auxiliary reservoir to the brake-cylinder, to set the brakes, the piston 29, with its supposed feeding groove, the stem 18 connecting the valve 22 to said piston, and the valve 17 for preventing the escape of air from the brake-cylinder during the application of the brakes, and afterwards permitting such escape to release the brakes, would, together, and in connection with the casing, constitute what is known in the air-brake art as a "triple valve;" would they not?

A. It would.

X Int. 94. In such a triple-valve apparatus, the valve 22 would be absolutely essential to the operation of the apparatus as a triple valve, and if said valve 22 were removed, the apparatus would cease to have any practical or useful function, would it not?

160 A. I do not at the present moment think of any situation wherein the modified Boyden structure referred to in the few preceding questions would serve any useful function when the valve 22 was removed, as stated in the last preceding question, although there may be situations where it would. It would not, in my opinion, be capable of serving the functions of a "triple valve."

X Int. 95. Now, assuming the triple valve of plate XI of the Boyden 1891 catalogue, modified simply as stated in X Ints. 81 and 82, and without the small hole in the stem being plugged, you have already testified that such structure would perform the functions of an ordinary "triple valve," but would not be a "quick-action triple valve." If, now, we should simply remove the fastening which is assumed to confine the check-valve 26 to its seat, then, thereupon and without anything further being done to the apparatus, said apparatus would become and be a "quick-action triple valve," would it not?

A. As I understand the present assumed construction, it differs only from the "quick-action triple valve" illustrated in plate XI in that additional means, viz., what is termed in patent 360,070 the "feeding groove 51," is added for the purpose of permitting main air or train pipe pressure to enter the auxiliary reservoir and restore the pressure therein to the desired limit, after such pressure has escaped from the auxiliary reservoir to the brake-cylinder, in applying the brakes or otherwise.

This additional means has only to do with the charging of the auxiliary reservoir and that alone, and this would not affect the operation of the balance of the apparatus in any way, shape or manner, except that the pressure in the auxiliary reservoir would be somewhat higher, when the "feeding groove 51" was added, than it would be when the auxiliary reservoir was fed or charged through

the check-valve 26 alone, and, therefore, the equalized pressure between the brake-cylinder and the auxiliary reservoir in applying the brakes with the maximum force of such reservoir would be slightly higher with the modified construction set forth in the question, than it would be when a structure precisely like that of defendants' 1891 catalogue was used.

From the above it is manifest that the modified Boyden "triple valve," as set forth in the present question, would be as much a "quick-action triple valve" as is the one shown in plate XI of defendants' 1891 catalogue.

X Int. 96. The gist of my question was this, to wit: that the simple removal of the fastening which was assumed to bind the check-valve 26 to its seat, would change the apparatus from a plain "triple valve" to a "quick-action triple." This is the fact, is it not?

A. The reopening of the passage by means of which main air or train pipe pressure can be directly admitted to the brake-cylinder by the removal of the obstruction which before closed it, namely, the check-valve 26 and the brazing which held it rigidly, and made it become a portion of the casing itself, and the resupplying of such reopened passage with a check-valve and its necessary seat and packing, which necessarily were destroyed in the brazing operation, would reconstruct the said modified Boyden triple valve, and restore it to practically its former construction, mode of operation and functions.

Simply taking the entire apparatus apart and putting the casing in the furnace, and reheating it to the extent necessary to melt the metal used in the brazing operation, and doing no more, which would be simply removing the means which fastened said check-valve to the casing and made it a portion of such casing, would not render the apparatus of any value as a "triple valve" or a "quick-action triple valve." In order to render such a mechanism capable of performing the functions of either a "triple valve" or a "quick-action triple valve," it would be necessary to reconstruct it as I have set forth.

X Int. 97. Brazing, however, was suggested by me only as one practical means of fastening the check-valve to its seat. As another means, the check-valve might be pinned to its seat, or the space between the check-valve 26 and the block 25 might be filled with a block or blocks of wood or other hard material, so as to prevent the check-valve from lifting from its seat. Assuming the check-valve to have been confined to its seat by pinning it thereto, or by putting a block of metal between it and block 25, large enough to extend from the check-valve to block 25, then the simple removal of such fastening would change the structure from a plain "triple valve" to a "quick-action triple valve," would it not?

A. In either of the cases suggested you have to go farther than "simple removal." You have to restore or reconstruct the several parts of the passage by means of which the direct admission of main air or train pipe pressure can take place to the brake-cylinder. And if the term "simple removal of such fastening" means such restora-

tion or reorganization, then I should answer yes; that such restoring or reorganizing of such passage, and providing the same with the check-valve 26 operating as shown in plate XI, did change the said modified Boyden structure from a "triple valve," capable of performing only the first two classes of work heretofore referred to by me, into a "quick-action triple valve," capable of performing all three classes of work heretofore referred to by me.

X Int. 98. All that would be necessary to change the supposed structure from a plain "triple valve" to a "quick-action triple valve" would be to remove the triple valve from its casing, take it apart, remove the fastening pin or block that held the check-valve to its seat, then put the parts together just as they were before the fastening pin or block was inserted, and restore them to the casing; am I not correct?

A. Not entirely. You might or you might not be, according to circumstances not stated in the question.

X Int. 99. What do you mean by that?

A. I mean that, in all probability, you would have to plug up the holes made by your fastening pin, and restore the parts to their original condition.

163 X Int. 100. My question assumed them to be restored to their original condition; and, with this understanding, I request you to give a simple, direct answer to the question, without any further evasion or quibbling. You know exactly what I mean by my question, and you are capable of giving a fair answer to it, if you will only endeavor to do so.

Witness states that he has given a fair answer to every question propounded to him by counsel for defendant, and that when counsel states that the witness knows what he (counsel) means, that he is assuming that witness is aware of what exists in counsel's mind alone, as witness thinks the last few questions and answers, as well as many which have preceded them throughout this examination, will clearly show.

By turning to X Int. 100, the present one, it will be observed that counsel states: "My question assumed them to be restored to their original condition," which is just what witness assumed the question to mean, although it did not state it in terms, and he restored them, that is, the several parts, in witness' answer to the questions from Int. 95 to 97 inclusive, and answered the questions fully and fairly.

A. The present question for the first time states what counsel means by "simple removal," which is the same meaning I had heretofore stated that I placed upon the term, and answered the question accordingly. With this understanding, upon which we are now agreed as it appears, I will say that the said modified Boyden structure, by such "simple removal" or restoration would become capable of performing the functions of a "quick-action triple valve," and that such "simple removal" or "restoration" would give to such structure the capacity for performing the third class of

work, which distinguishes a "triple valve" from a "quick-action triple valve."

X Int. 101. Then it would thereby be changed from a plain "triple valve" to a "quick-action triple valve," would it not? Please give me, for once, a direct answer, yes or no, to a simple, square question which properly admits of no other answer.

A. It would, as I have repeatedly stated.

X Int. 102. We will now drop the modification of the Boyden structure shown in plate XI, and refer to the structure as it is illustrated in said plate. In that plate I find an annular part around the enlarged and hollow stem of the triple-valve piston, just above the piston itself, and marked 9 on said plate. On page 29 of the Boyden 1891 catalogue said part 9 is termed a "sleeve bushing." What do you understand to be the function of that part and its passage B in the operation of the Boyden quick-action triple valve?

A. One of the functions of such part I understand to be providing the casing or chest with a metal which will wear smoother and to a less extent by the repeated movements of the piston stem back and forth through it than the metal of which the main portion of the casing or chest is composed. Another function is to more readily provide a bearing of the proper length for the triple-valve piston than would be the case if the bearing was constructed upon and integral with the main body or portion of the casing or chest.

This "sleeve bushing" 9 does not have the passage B constructed in it, but the passage B is constructed in the main portion or body of the casing or chest, as clearly appears upon said plate XI of defendants' 1891 catalogue.

I have not the slightest objection to stating what my understanding of the function in the construction, as above stated, of the port or passage B is, if counsel desires it.

X Int. 103. Have you stated all the functions of the sleeve bushing?

A. I have the special functions. Of course, there is the general function of closing up the space between the piston stem and the main portion or body of the casing or chest to the extent possible, and yet have such piston stem move back and forth through it freely, and form a portion of the casing or chest in which the piston chamber D is constructed, and thus forming a portion of such chamber. I believe the above are all the functions of the sleeve bushing 9.

X Int. 104. If said space were left open and unobstructed, and having a capacity as large as, or larger than, the passage A leading from the auxiliary reservoir, would the apparatus perform the functions of a "quick-action triple valve"?

A. Probably not, although it is not definite what the size of the passage A is relatively to the port or opening made by the unseating of the auxiliary valve 22 to its extreme extent and the passages which I have marked upon said plate XI *h, h*.

It would depend upon the relative sizes of these several passages whether the pressure in the chamber C was reduced considerably

below the pressure in the auxiliary reservoir, and also that in the main air or train pipe.

It will be remembered that in my direct examination I explained at length the operation of said Exhibit "Defendants' Quick-action Triple Valve," as illustrated in said plate XI of said Exhibit Defendants' 1891 Catalogue, as well as the underlying principles of "quick action."

Defendants' counsel objects to this answer being continued any further with needless explanations and repetitions, because the question was fully answered by the first two words, "Probably not," and the rest is mere waste of time.

(Answer continued.) If the passage A of said plate was of the thickness of ordinary writing paper, it would show precisely the same as it is shown in said plate XI; and, if this was the case, then, unquestionably, the mechanism shown in such plate would be a "quick-action triple valve," but probably not as good a one as it is now.

166 I mention these facts simply to show that there was nothing definite about the question, and that in the opening part of my answer I assume that the probabilities were that the passage A was of sufficient size to defeat the fundamental or underlying principle of "quick action."

X Int. 105. Referring to the structure illustrated in plate XI of the Boyden 1891 catalogue, if the check-valve 26 and the spring 27 were simply removed therefrom, without making any other change in the structure, such removal would defeat the operation of the device, both for the purposes of a plain "triple valve" and for the purposes of a "quick-action triple valve," would it not?

A. I believe that substantially it would if the passage B leading from the chamber C to the auxiliary reservoir portion of the piston chamber D was sufficiently large to permit auxiliary reservoir pressure to return to the main air or brake pipe as fast as or faster than the pressure in such pipe was reduced. But we have no sufficient data upon which to form an intelligent opinion on this point. It would depend wholly upon the size of the opening B as to whether such removal would or would not defeat the mechanism shown in said plate XI in performing the functions of a "triple valve" or a "quick-action triple valve."

There is no doubt but what it would interfere with the functions to be performed by a "triple valve," or a "quick-action triple valve," but as to the extent of such interference I cannot state, for the reasons heretofore given in this answer.

X Int. 106. Again: Referring to the structure illustrated in plate XI of the Boyden 1891 catalogue, if the large valve 22 were simply removed therefrom, without making any other change in the structure, such removal would defeat the operation of the device, both for the purposes of a plain "triple valve" and for the purposes of a "quick-action triple valve;" would it not?

A. Certainly; the same as the removal of any other part, as the easing or chest, would do.

167 X Int. 107. Referring to the structure illustrated in plate XI of the Boyden 1891 catalogue, if the hole in the stem 1 were plugged up, without making any other change in the structure, would such change defeat the operation of the device either for the purpose of a plain "triple valve" or for the purposes of a "quick-action triple valve," or would it still be capable of performing the functions of both?

A. It would in an imperfect manner be capable of performing the functions of both, for the simple reason that the first class of work to which I have heretofore referred, viz., making "graduating applications," would be, in my opinion, very seriously interfered with, if no other changes were made. But I have no doubt that they could be made after a manner similar to some of the older forms of "triple valves," where such work was imperfectly performed.

X Int. 108. Referring to the structure illustrated in plate XI of the Boyden 1891 catalogue: In making an "emergency" stop with said structure does not the stem 18 pull the valve 22 from its seat before the check-valve 26 becomes unseated, so that, for a moment, what you call the passage leading from the main air pipe or train-pipe to the brake-cylinder is closed, although the valve 22 is open; and does not the reduction of air pressure that then takes place in the valve chamber C, force the check-valve 26 from its seat, and thereby open such passage from the train-pipe to the brake-cylinder?

A. As I described in my direct examination, the collar *m* on the portion 18 of the main valve 17-18 comes in contact with the auxiliary valve 22, and lifts such auxiliary valve off its seat to a certain extent, which extent is sufficient to produce a port or passage of greater capacity than that of the passage B leading from the auxiliary reservoir portion of the piston chamber D into the chamber C, and this is done before the auxiliary valve 22 has opened its port or passage to the full extent. And before it is opened to such extent,

I believe that the pressure in the chamber C will expand or
168 escape through the port or passage made by the unseating of the auxiliary valve 22, as before described, into the chamber H, and thence through the passages *h h* into the brake-cylinder, reducing the pressure in said chamber C far below that in the main air or train pipe, which reduction permits the superior force of the main air or train pipe pressure to force the check-valve 26 off from its seat before the auxiliary valve 22 is unseated to its full extent; from which it follows that there is no appreciable time between the unseating of the auxiliary valve 22 and the opening of the said check-valve 26. The reduction of pressure in the chamber C, as before stated, permits the main air or train pipe pressure to force the check-valve off its seat, as described; but said reduction never forces it off; it only permits it to be forced off.

X Int. 109. In making an "emergency" stop with the Boyden "quick-action" apparatus, do not the auxiliary reservoir air and the train-pipe air meet and mingle in the valve chamber C, and both together pass simultaneously through the same port (to wit, the port controlled by the valve 22) to the brake-cylinder?

A. If the ports or openings *i j* and the passage *k* connecting such

ports or openings together were added to the port or passage made by the unseating of the auxiliary valve 22, I should answer yes.

X Int. 110. I was merely asking with reference to what would take place through the large port controlled by the valve 22; and, with that understanding, would you not answer "yes," without any qualification?

A. To a certain extent, I would.

X Int. 111. The great proportion or larger quantity of the commingled reservoir and train-pipe air would pass through the port of the valve 22, would it not?

A. I should expect that it would. I am not prepared to say to what extent the two pressures would commingle in this chamber C before passing into chamber H, for it will be seen that the auxiliary reservoir pressure is greater than that of the main air or train pipe pressure, and also that it is greater than that in
169 the brake-cylinder, which is necessarily below that of the main air or train pipe pressure.

X Int. 112. In the structure shown in the Boyden 1889 catalogue, plate IX, that part which corresponds to the piston stem 18 of plate XI in the Boyden 1891 catalogue is cut in two or made in two separate pieces, is it not?

A. It is, as I stated in my direct examination; that is, the parts corresponding with the main valve 17, 18, of the said "Exhibit Defendants' Quick-action Triple Valve," as illustrated in plate XI of said "Exhibit Defendants' 1891 Catalogue," is, in the structure shown in plate IX of said "Exhibit Defendants' 1889 Catalogue," made in two parts.

I do not know to just what portion or to what extent the said main valve 17-18, as the same is shown in said "Exhibit Defendants' 1891 Catalogue," is used to make up the "stem 18" of the present question. I would naturally understand that it was made up of that portion of the main valve 17-18, between the so-called "leather cup" 17 and the valve portion, made up of the ports or openings *j*, *i*, and the passage *k*, connecting the same. If such is the meaning of the question, then the part which corresponds with such "stem 18" would be in one piece only, and not in two pieces.

X Int. 113. In plate IX of defendants' 1889 catalogue the division line between the two parts referred to is indicated by the transverse line across the stem, between the figures 13 and 17, where the section lines of the drawing take opposite inclinations, is it not?

A. That depends upon what the present question means. If it is the division line between the two parts of the main valve 17-18, I would answer yes; but if it is between the two parts of the "stem 18" I should answer that it was the line showing where the corresponding stem in said "Exhibit Defendants' 1889 Catalogue" ended, and not a division between two of its parts.

Defendants' counsel states that this is mere verbal criticism of the question, and that he has not time to wait for it, but will proceed with another question.

(Witness continues :) The part marked 13 of said plate IX of said defendants' 1889 catalogue on page 24 thereof is called the "graduating valve," and the part on the same plate designated 17 is called "release-valve stem."

X Int. 114. The fact that in the structure of plate IX of the Boyden 1889 catalogue the release valve and its stem are separate from or not integral with the part marked 13 on said plate, does not prevent the release valve from being a part of the triple valve, does it?

A. No.

Defendants' counsel states that, having gotten one direct, categorical answer to a question, he now closes the cross-examination.

HENRY F. NEWBURY.

Adjourned to meet upon agreement of counsel.

171 United States Circuit Court, District of Maryland.

GEORGE WESTINGHOUSE, JR., <i>et al.</i>	}	In Equity. No. 321.
<i>vs.</i> BOYDEN POWER BRAKE COMPANY <i>et al.</i>		

It is hereby stipulated and agreed that H. Herman Westinghouse and Henry B. Stone would, if called and sworn in this cause, testify as they have testified in the accompanying printed copy, which is identified by the signatures of counsel, and that their depositions as printed in said copy may be used and read at the hearing with the same force and effect as if taken in this cause.

It is further stipulated and agreed that either or both of said witnesses shall, if desired by counsel for defendants, be produced for cross-examination at such time as may be agreed upon by counsel, it being understood and agreed that H. Herman Westinghouse shall attend for cross-examination either at Chicago or Baltimore, as may be hereafter determined by counsel for defendants, and that Henry B. Stone shall attend for cross-examination at Chicago. Waiver of cross-examination by counsel for defendants shall not operate to affect the admissibility of the deposition or depositions in chief.

New York, January 18, 1891.

GEO. H. CHRISTY,
J. SNOWDEN BELL,
For Complainants.
LYSANDER HILL,
Of Counsel for Defendants.

172 H. HERMAN WESTINGHOUSE, a witness produced on behalf of complainants, having been duly sworn, deposes and says in answer to interrogatories propounded to him by J. Snowden Bell, Esq., of counsel for complainants, as follows, to wit:

38 Q. What is your name, age, residence and occupation?

A. My name is H. Herman Westinghouse; age, thirty-eight years; residence, Pittsburgh, Penn.; I am general manager of the Westinghouse Air Brake Company of Pittsburgh, Penn.

39 Q. For how long have you been connected with the said company?

A. Since the year 1872.

40 Q. To what extent have you become familiar with the construction and operation of fluid-pressure brake mechanism for railroads?

A. My experience has been such as to make me entirely familiar with their construction and operation. My first employment in connection with the Westinghouse Air Brake Company was in their foundry, afterwards in their machine shops, and then in their draughting and designing department. I was subsequently engaged in the application and operation of brakes to railway trains in service, and I then became general agent of the company for the introduction and sale of their apparatus. I am familiar with all the experiments and trials that led to the development of improvements, and in the winter of 1887 was made general manager of the Westinghouse Air Brake Company.

41 Q. Will you please explain what is meant by the term "quick-action automatic brake," as that term is understood and applied in practice, relatively to what are ordinarily known as "automatic brakes."

A. "Automatic brakes," as generally used upon trains of considerable length, perform all of the usual operations of braking, for what are known as "service stops," in an entirely satisfactory manner. By "service" stops I mean such as are usually

173 employed in operating trains in transacting the regular business of railroads—in contradistinction to those stops which are called "emergency stops." By "emergency" stops I mean those that require trains to be stopped as quickly as possible, to prevent accident or disaster.

To render the operation of brakes, in "service" stopping, satisfactory and economical, the result of practice has determined that the amount of braking power should be limited to a degree that will render it possible to operate the brakes without reasonable liability of locking the car wheels when in motion. Such a result is objectionable, as by means of it flat spots are worn in the periphery of the wheels and they are rendered unfit for further service.

In the operation of automatic brakes for "emergency" purposes, on trains of considerable length, their application is necessarily retarded to a considerable degree, and this feature, combined with a necessary limitation of power, as heretofore explained, causes the

stopping effect to be considerably less than the maximum theoretically obtainable result.

The construction of "quick-action" automatic brakes is such as to provide for all of the requirements of "service" stopping, equally as well as those functions have heretofore been performed by the "automatic" brake system, and they are additionally arranged so that when "emergency stops" are made, there is practically no delay in the full application of the brakes, and there is also a considerable augmentation of power, as compared with that available in "service" applications.

The features of substantially instantaneous action and augmented power in "emergency" applications, constitute the distinguishing features of the "quick-action" automatic brake as compared with the ordinary "automatic" brake.

42 Q. Will you explain by what means or appliances, other than or different from those employed in "automatic" brakes, the function of more rapid and powerful application which you have mentioned is attained in "quick-action automatic" brakes?

A. The improved operation heretofore described is obtained by an addition to the mechanism of the triple valve, which causes the prompt and more powerful application of the brakes in "emergency stops."

43 Q. By what term is a triple valve, provided with the addition mentioned in your last answer, designated in the art?

A. It is called a "quick-action triple valve."

44 Q. Please examine Complainants' Exhibit "Complainants' Catalogue" and indicate such illustration or illustrations therein as correctly represent "quick-action triple valves" manufactured by the Westinghouse Air Brake Company and furnished to railroads by such company?

A. The illustration of the "quick-action triple valve" is found in "complainants' catalogue" on plates D¹, D²², D²⁶ and D³¹. On plate D¹ the "quick-action triple valve" is represented on the left side of the plate, and is represented as attached to a brake-cylinder designated "10-inch brake-cylinder."

45 Q. Will you state approximately to what extent "quick-action triple valves" substantially similar to those illustrated as stated in your last answer, have been manufactured by the Westinghouse Air Brake Company and furnished by them to railroad companies?

A. They have been furnished substantially to the exclusion of all other forms since December, 1887, and there are now about 125,000 in general use.

From an extended knowledge of their performance they are regarded as giving entire general satisfaction.

46 Q. When and by whom, so far as your knowledge and information extend, were "quick-action automatic brakes" originated and introduced into practical railroad service?

A. They were invented some time during the year 1886 by George Westinghouse, Jr., and were practically introduced by the Westinghouse Air Brake Company, of which he is president, during the year 1887.

47 Q. Please state the circumstances which led to the introduction of "quick-action automatic brakes" into practical railroad service, and the results which have been attained by their use therein?

175 A. In 1885 the Master Car Builders' Association, an organization composed of those having charge of the construction and maintenance of car equipment upon railroads in the United States and Canada, and also of those engaged in the manufacture of cars for sale, appointed a committee to investigate the relative merits of several brakes that were represented by their owners as suitable for general use upon freight cars. After obtaining such information as was available, this committee reported to their association that the subject was of such importance that information necessary to enable them to form a conclusive judgment was not available, without the aid of experiments or tests of the different forms of brakes under conditions that would fairly represent the average practice of railroads.

This report led to a series of tests, conducted under the supervision of the committee of the Master Car Builders' Association, in which the several makers of car-brakes were requested to participate. The committee selected a train of fifty freight cars, as in their judgment representing the longest average train practical in general service, and the different brake manufacturers were required to furnish brakes to operate upon trains of this length. Provision was made to have the tests comprehend all of the functions that could reasonably be expected of the brake apparatus, with a view to making the results as comprehensive as possible, thereby making it possible for those interested in the use of power brakes to purchase apparatus that would render satisfactory service.

Provision was also made for what were called "endurance" tests, it being the intention of the committee to place in general service (after the trials had taken place) the brakes which had been offered for trial. The object in view was to ascertain, after a stated period, the extent to which the efficiency of the brake apparatus had been impaired by use.

The tests were formally opened July 13, 1886, and continued without interruption till August 3. Five different forms of apparatus were tried as far as possible under the prescribed conditions.

176 The Westinghouse Air Brake Company furnished fifty sets of their standard automatic freight-brake apparatus, and they were identical with about 50,000 sets that had already been furnished by them for use upon roads located principally west of the Missouri river. This form of brake gave satisfactory service where it had been used. The roads adopting it had extremely heavy grades and the length of train was necessarily limited, and, therefore, the absence of the quick-action element was of less consequence than if trains of greater length had been generally possible.

The fact that maximum efficiency in train-stopping was not realized in "emergency" cases was not generally commented upon,

probably for the reason that the results arrived at were much superior to anything that had been theretofore attained.

The committee in their report upon these trials make the following statements, which I quote from the report of the proceedings of the Master Car Builders' Association, June, 1887, pp. 112, 113 :

"The results of these 1886 tests were disappointing. None of the competitors, in the estimation of your committee, did satisfactory work, owing to the violent shocks produced in stopping. Slack in long trains controlled with power brakes applied successively from the engine, assumed at once a most prominent part in this and, doubtless, all future contests. The expected delays in discharging and releasing continuous brakes were shown to be of no moment, and while the objections of successive application was developed to an extent calling for the most serious consideration.

* * * * *

"Your committee's work, as laid out at the Harrisburg meeting of January 6, 1886, had in contemplation an endurance test of nine months' regular service. The contest, however, had developed so many points where improvements might be made, that at a meeting held in New York, in the month of September following 177 the 1886 contest, it was decided to abandon the endurance test and its restrictions."

While the fact was well known that automatic brakes are necessarily applied successively, that is to say, one after another instead of simultaneously, these tests were the first practical demonstration that the interval of time between the applications of the brakes upon the several cars could be so great as to become a dangerous and objectionable element of operation of brakes on long trains and in making "emergency" applications. As shown by the report of the committee, when the brakes were applied with full force to the front portion of the train, and before movement could be communicated to those upon the rear portion, the front of the train would be retarded sufficiently to produce a collision between it and the part of the train upon which the brakes were not yet in full operation. The opportunity for such action is, of course, brought about by the lost motion or "slack" that becomes necessary in coupling cars together, and providing for the necessary motion of the springs of the draft rigging.

Stated in reasonably exact terms, in a train of fifty cars there is usually not less than twenty-five feet of lost motion, and this is generally exceeded.

The degree of this collision or shock was determined by a registering device called a "slideometer." The following quotation from the committee's report (p. 84) will explain its construction and operation. It also states the amount of shock which the committee considered inadmissible in general service :

"The device consists of a wooden trough, 14 feet long by 6 inches wide, made of clear white pine, smoothly planed. This trough is screwed fast to the centre of the rear car. In the trough slides, in either direction, a wrought-iron weight 5 inches in diameter and 3

inches high, weighing 16½ pounds. Crude as the device may appear, it has answered its purpose perfectly, registering all the various demands made by the competitors. Whether a violent shock forward, of from 50 to 150 inches, a jerk backwards, or a succession of rapid forward and backward movements, the slideometer always told the story, and doubtless met the different demands on it much better than more elaborate devices which might have been prepared could the importance of some such gauge been foreseen. Its simplicity adds to its value, as it could be readily produced in any locality for testing purposes, or drilling men in handling long trains, etc. Shocks, in ordinary handling of trains with slack couplings, over sags, hogbacks, and working in yards, will move the disk from 2 to 8 inches; 12 inches has been estimated as sufficient to be injurious to live stock and equipment. Repeated blows of from 12 to 20 inches, in the mixed and loaded car test, were sufficient to start the loads at the rear end of the train, through the ends of the cars; the loaded cars thus, through the movement of their loads, becoming a check in weighing the length of the slideometer movement that was admissible and inadmissible."

The maximum shocks developed by these tests are stated in the committee's report on page 96, from which the following quotation is made:

"The horizontal lines show the speed in miles per hour, while the vertical lines show the time at five-second intervals. The figures show the time in minutes. Allowing thirty seconds to reduce the speed to fifteen miles an hour, the run should have occupied about seven and one-half minutes. The diagrams show very plainly great room for improvement in both the Eames and the Westinghouse brakes, and, were it not for the low speed, would apparently give the award to the American Brake Company, for, up to nine minutes, it will be observed, the speed is uniformly maintained between eight and ten miles per hour. This record, however, it should be borne in mind, was taken in the autographic car placed in the middle of the train. While the persons riding in this car and the dynamometer car were commenting upon the uniformity of the run that was being made, although somewhat below the fifteen-mile speed, an entirely different record was being registered in the rear or 52d car. Here shock after shock was being received, their rapid succession adding to their intensity. Twenty-eight blows, of more or less severity, were given during the run of eleven and one-half minutes, culminating in a shock of sixty-three inches, which broke the train in two. An examination of the train after the stop revealed the fact that nine of the rear cars had their ends broken and bulged out, by the shifting of the loads, to such an extent that they were in a dangerous condition, and this, notwithstanding the fact that the wheels with which the cars were loaded had been stowed with special care, and the ends of the car blocked with timber. This test was more instructive than any other could possibly have been, in showing the inherent weakness of brakes actuated by independent pulsations or blows transmitted through the draft springs. The second is all the more prominent,

as, notwithstanding the shock-producing powers developed by the continuous brakes in fifty-car train stop, their down-grade runs were comparatively free from shocks."

With the train fitted with the Westinghouse automatic brake the maximum shock was forty-nine inches on "emergency" application.

An examination of this report will reveal the demonstration of the fact heretofore stated that it is only in "emergency" applications that the objectionable features described were developed, and careful investigation readily reveals the cause for different action in the two methods of application of the brakes.

Automatic brakes as constructed require the location upon
180 each car of a cylinder with a piston for bringing brake-shoes into contact with and releasing them from the wheels; a storage reservoir, known as an "auxiliary reservoir," for holding a supply of air under pressure for the purpose of operating the piston of the brake-cylinder when the brakes are to be applied, and a valve mechanism known as a "triple valve," which controls the supply of air to the auxiliary reservoir, also from the auxiliary reservoir to the brake-cylinder, and finally when the brakes are to be released from the brake-cylinder to the atmosphere. The supply of air for the auxiliary reservoir is obtained by a line of pipes with flexible hose and couplings extending from car to car which is called a "train-pipe;" and this "train-pipe" is connected on the locomotive to a main storage reservoir, to which compressed air is supplied by a pumping mechanism.

The movement of the "triple-valve" mechanism is the means of permitting the compressed air stored in the auxiliary reservoir to pass into the brake-cylinder for the purpose of causing the brakes to be applied.

The normal condition of the automatic brake system when ready for use, but when the brakes are not being actually operated, requires a uniform pressure of compressed air in the train-pipe, triple valve and auxiliary reservoir. To cause the mechanism of the triple valve to operate so that the brakes may be applied, it is necessary that the air pressure in the train-pipe be reduced to a greater or less degree, depending upon the force with which it is desired to apply the brakes. This is done by means of an operating valve or cock, called, ordinarily, an "engineer's valve," located upon the locomotive, by means of which communication is first closed between the main air reservoir and the train-pipe, and an opening is effected from the train-pipe to the atmosphere.

From the foregoing explanation, it will be clear that the triple valves in a train of cars will operate when there is a reduction of pressure in the train-pipe contiguous to the triple valves; and if for any reason the reduction of pressure is not uniform or identical throughout the train-pipe, it is manifest that there will
181 be a lack of uniformity in the application of the triple valves, and consequently in the time of application of the brakes.

It has been experimentally determined that in a train-pipe of the extreme length used in general practice, a moderate-sized opening

the atmosphere may be made in one end, by means of which a substantially uniform reduction of pressure will be made through the entire length of the train-pipe. If, however, a considerable opening is made to the atmosphere, thereby effecting a great reduction of pressure at one end of the train-pipe, the friction of the compressed air moving through the train-pipe will retard its flow, causing a considerable reduction of pressure in the vicinity of the opening, as compared with that at the opposite end of the train-pipe.

As heretofore explained, the degree of force with which the brakes are applied depends upon the reduction of pressure made in the train-pipe. It is, therefore, clear that when the moderate and uniform reduction of pressure required for a "service" stop is made, the movements of the several triple valves will be substantially simultaneous upon all the cars of the train, and the action of the brakes will be in accordance therewith. This produces a uniform retardation of each car in the train, and does not create or cause a tendency in the different portions of the train to change their relations to each other.

When, however, it becomes desirable or important that the brakes should be applied with the greatest possible force, it is necessary that the train-pipe pressure be reduced as rapidly as possible; and in the "automatic" system of brakes this is accomplished by opening a communication between the train-pipe and the atmosphere of the greatest practicable size. In doing this there is necessarily a much greater reduction of pressure in the immediate vicinity of the opening in the train-pipe, for a period of time, depending upon the length of the pipe, compared with what takes place in portions of the train-pipe more remote from the discharge opening. The effect of this uneven reduction of pressure in the train-pipe is to cause those triple valves so located as to be operated by the earlier and greater reduction of pressure, to apply their brakes quicker and temporarily with greater force than those valves more distant from the opening. Brakes are, therefore, applied upon those cars more favorably located, relatively earlier and with greater force than those in other portions of the train; and the motion of their cars is arrested to a greater degree. The portions of the train in which the speed has not been equally reduced move forward the amount of slack motion that exists in the train, until they come in contact or collision with those portions upon which the brakes have been applied more promptly and with greater force, owing to the reasons already explained.

The degree of shock or collision will depend upon the differences of degree and time of application of the brakes upon different portions of the train. In the design of automatic brakes it was considered desirable for constructive reasons to limit the size of the passages in the triple valve making communication between the auxiliary reservoir and brake-cylinders; and for this reason a period of about three seconds was required to obtain the maximum brake-force from the time that the triple-valve mechanism commenced to admit air from the auxiliary reservoir to the brake-cylinder. This

is, however, a characteristic of all triple valves of this type, and does not affect their periods of operation relatively to each other.

The report of the committee of the Master Car Builders' Association upon the results of these trials has heretofore been quoted from. While they did not find that any of the competing brakes met the prescribed conditions, for the purpose of comparison with future trials it is important to state the observed facts in reasonably exact terms.

Taking the train of the Westinghouse Air Brake Company as representing the best average performance, it will be found that an average distance of 350 feet and a period of seventeen seconds was required in which to stop a train of fifty empty cars running on a level track at a speed of twenty miles per hour, and that it required an average of twelve seconds to fully apply the last brakes on the fifty-car train. These deductions are made from information to be found in plates 9, 10, 11, 12 and 13, series A, 1886, of the Master Car Builders' Association's Report for 1887.

As these trials were the first attempt to operate brakes upon trains of great length, it was only at this time that the inability of the automatic brake to meet every practical requirement of freight-train breaking was developed, and the importance of the investigation to those who desired to make use of power brakes on freight trains can scarcely be overestimated. As bearing upon this point I refer to page 76 of the Report of the Master Car Builders' Association for 1885, in which it is stated that the committee found in actual service more than 2,800 of what was called the American buffer brake. This device, while having acknowledged limitations, had made very satisfactory demonstrations upon trains of fifteen or twenty cars, and as its first cost was comparatively low, considerable headway had been made, as found by the committee, in introducing it. At the trials at Burlington in 1886, when an attempt was made to operate it upon a train of fifty cars, the results were so disastrous as to seriously injure several of the cars of the train. After this exhibition no further attempt was made by the owners of this device to extend its use, as it was clearly demonstrated that all previous expenditures made by those purchasing the apparatus was a complete loss.

An examination of the results obtained led George Westinghouse, Jr., to make investigations with a view to so changing the form of brake apparatus as to have the effect of operating with a less interval of time between the apparatus on the several cars, and also, if possible, provide for a greater available force, so as to arrest the motion of the train in a less distance than had been done at the

1886 Burlington trials. The functions of graduated or "service" stopping being already satisfactorily performed, it was highly desirable that these should not be interfered with; and experiments were therefore directed to obtaining the same uniformity of action, as nearly as possible, as existed in the service operations of the apparatus.

That absolute coincidence of operation is not required was amply

demonstrated by the performance of many thousand brakes upon short trains. Such difference as exists in the times of operation of the different valves, as heretofore explained, had not up to the time of the Burlington tests been of a sufficient degree as to be a source of unfavorable comment by those having the brakes in operation, owing to the fact that experience had been limited to short trains, upon which the objectionable action does not take place.

To enable experimental work to be reliable in judging results, the conditions that existed in a train of fifty cars were duplicated as far as possible. Fifty complete sets of brake apparatus for cars were arranged in close proximity to each other, so that their operation could be readily observed, and these were connected together by the proper length of train-pipe, with the usual hose couplings and cocks required in actual service, the length of the train-pipe being equal to that required for a fifty-car train. This apparatus was erected in the works of the Westinghouse Air Brake Company, and was provided with electrical recording apparatus to accurately determine the relative time of application of the several brake mechanisms. As before stated, it was found that a period of twelve seconds elapsed before the full application of the first and last brake-cylinder, when air was exhausted from one end of the train-pipe, in the usual manner of operating the automatic brake for "emergency" purposes.

By placing in the train-pipe, at regular intervals, a form of delicately adjusted exhaust valve, it was found possible to cause them to operate by the moderate reduction used in "service" applications. The operation of these valves caused air to be exhausted from the train-pipe, wherever they were located, and, their action being nearly simultaneous, the effect of their operation was to cause a nearly uniform application of all the brakes, practically coincident with the exhaustion of the air at the forward end of the train-pipe.

The construction and operation of this auxiliary discharge valve was of an extremely delicate nature, to a degree which would render its practical use extremely doubtful. It served, however, to demonstrate the direction of further experiment.

I have heretofore referred to the functions of the triple valve, by which air is conveyed from the train-pipe to the auxiliary reservoir, then from the auxiliary reservoir to the brake-cylinder, with a greater or less degree of force as circumstances require, and finally from the brake-cylinder to the atmosphere for the purpose of releasing the brakes. These operations are performed by means of a valve mechanism, controlled by the movements of a piston operated upon by air pressure. And all the operations of supplying the auxiliary reservoir, admitting air to the brake-cylinder of limited pressure, and of discharging the air from the brake-cylinder for the purpose of release, are performed by a partial movement of the piston and valve mechanism of the triple valve. It is only for "emergency" applications or quick stops that the final and complete movement of this piston and valve is required. This final movement is obtained by a rapid and considerable reduction of pressure

in the train-pipe, as compared with what is required for "service" operations.

Advantage was taken of these conditions to arrange an auxiliary-valve device controlling communication between the brake-pipe and the atmosphere, which was caused to operate by the final or complete travel of the piston of the triple valve when a considerable reduction of pressure was made at one end of the train-pipe for emergency or quick stops. With the aid of this device there was a complete exhaustion of the air from the train-pipe at each triple valve, which accelerated the operation of the brakes to a degree that reduced the time of full application on the last car from twelve seconds to six seconds.

186 From the operations as previously described it is plain that in the process of applying brakes the air that was necessarily exhausted from the train-pipe to cause their application was wasted—at least it performed no other service than that of moving the valve and piston of the triple valve; and this was equally true of the automatic brake system and of the auxiliary-valve device just described. The discharge port from the auxiliary valve was therefore connected with the brake-cylinder, instead of leading it to the atmosphere. The effect of this modification was to cause a considerable amount of the pressure in the train-pipe to pass into the brake-cylinder, where it contributed to that regularly supplied by the auxiliary reservoir, augmenting the brake force fully twenty per cent. in emergency or quick applications.

The value of this modification will be better appreciated by referring to that portion of my testimony in which is explained the necessity for a limitation of the braking power in "service" applications. In fact, theoretical considerations would suggest two independent brakes of different degrees of power or force; one of them to be used for "service" operations, to be limited in power to a point that would render the locking of car wheels impossible; the other to be used only in "emergency" or quick stops, and calculated to exert a much greater force, thereby overcoming the speed of the train in the least possible time and distance. With these considerations thoroughly understood, the value of the invention of the auxiliary-valve device for exhausting the train-pipe pressure into the brake-cylinder for emergency applications is made clearly evident.

Another feature of material importance was the fact that these improvements were made without in the slightest degree, interfering with the operation of the triple valve in respect to the important duties it already satisfactorily performed. Valves of the new construction were used in connection and in common with those of the automatic system, and the change did not in any sense impair the value of what had previously been furnished.

Provision was made whereby the benefits of the improvement were applicable to the automatic apparatus already in use. This was accomplished by a form of valve mechanism entirely independent of the triple valve of the automatic system, and arranged to control communication between the brake-pipe and

the brake-cylinder. The construction of this valve was such as to cause it to remain inactive or inoperative when a moderate reduction of pressure was made in the train-pipe. When, however, a sudden or considerable reduction was made, the valve mechanism operated and opened communication between the train or brake pipe and the brake-cylinder, producing a result identical with that of the improved or "quick-action" type of triple valve.

The experiments and improvements and changes above described were carried on by the suggestion and under the direction of George Westinghouse, Jr.

The possibility of constructing an air brake in which the actuating valve should be controlled by electricity seems to have been first conceived by George Westinghouse, Jr., as he took out a patent for such a combination. It has since expired. It was not felt that the attainable benefits by the use of electricity would compensate for the many unreliable qualities of such a method of operating valves. The experience of the 1886 trials, however, conclusively proved that extraordinary means would probably be justified, provided the elements already employed failed to meet the specified requirements of the Master Car Builders' Association.

The 1886 experiments clearly demonstrated the necessity of the coincidence of operation of the several brakes in a train to a greater extent than was realized with any that were tested. By the improvements described in triple-valve construction, the interval of application between the first and last cars of the test train was reduced from twelve to six seconds. Whether or not this improvement was sufficient to overcome the developed objections could only

be determined by trial upon a train in actual operation. It was, therefore, deemed advisable to provide an exhaust-valve mechanism to be operated by electricity, capable of being inserted in the train-pipe as frequently as circumstances proved necessary. Valves of this kind were successfully constructed, and when placed in the brake-pipe were caused to operate so as to exhaust a small quantity of air from the brake-pipe when emergency applications were made. Two of these valve devices, placed at regular intervals in the brake-pipe, were found to be sufficient to produce an instantaneous and uniform application of all the brakes of a fifty-car train.

The important developments made by the 1886 trials naturally led to provisions for similar tests, under practically the same conditions, by the Master Car Builders' Association. Due notice was given to all those interested in the subject, and a period extending from August, 1886, to May, 1887, was given the various competitors in which to make modifications and improvements that were made clearly necessary by the 1886 experiments.

In May of 1887 five companies were represented, all of them furnishing what is known as "continuous" brakes, being the class in which an actuating connection is made from car to car and with the locomotive. Of these, one was operated solely by electricity; one was operated by compressed air alone; and three were operated by a combination of compressed air or atmospheric pressure and elec-

tricity. The apparatus furnished by the Eames Vacuum Brake Company and the Westinghouse Air Brake Company were capable of performing all functions without the aid of electricity. The Carpenter electro-air brake could only be operated by the combined use of air and electricity.

The prescribed experiments were made, and the train of the Westinghouse Air Brake Company was the first subjected to test. In making "emergency" stops without the aid of electrical attachments, the shocks experienced in the preceding year were greatly exceeded, reaching a maximum of 103 inches as compared with the maximum of 49 inches in the 1886 trials. In fact they were so severe 189 that it was not deemed prudent to use the brake in "emergency" applications without the use of the electrical valves herebefore described. When these were used, the desired coincidence of operation was secured and stops were made without perceptible shock.

These results were duplicated in this respect by the other brakes having electrical methods of application.

In the Report of the Master Car Builders' Association (pp. 183, 184) is stated the result of the committee's investigation, which I quote as follows:

"At the conclusion of the 1886 trials, the committee felt that to sum up any results in the face of so large a field for improvement could not but be unsatisfactory, and, while a wonderful advance has been made in the brake problem, as will be seen by a comparison of the stops of each year, the 1887 tests apparently leave the field for improvement open as wide as in 1886. The Widdifield & Button and the Rote buffer brakes, hopeful over the shocks given by the atmospheric brakes, are fitting up or have fitted trains to pursue their investigations; the Westinghouse Brake Company, unwilling to accept as final their May, 1887, record, is making changes in valves and pipings, by which they hope to make short 50-car emergency stops, without objectionable shocks and without the aid of electricity; the American Brake Company, convinced that buffer brakes cannot compete with the continuous, is about testing a 50-car train, fitted with a new electro-atmospheric brake.

"While we are not prepared to make any definite recommendation at this writing as to what freight train brake should be generally adopted, our present information, derived from the recent tests, points to two conclusions:

"First. That the best type of brake for long freight trains is one operated by air and in which the valves are actuated by electricity.

"Second. That this type of brake possesses four distinct advantages:

190 "(a.) It stops the train in the shortest possible distance.

"(b.) It abolishes shocks and their attending damage to equipment.

"(c.) It releases instantaneously.

"(d.) It can be graduated perfectly.

"The further question as to whether electricity is a sufficiently

reliable element to use in freight-train service is one that can only be determined by experiment; but, we think, the benefits derived from electricity are so manifest that the experiment is well worth trying. In view of the foregoing and of the improvements that the buffer and atmospheric brakes are making, your committee recommends that the subject of automatic freight-train brakes be continued for further investigation.

"GODFREY W. RHODES,

"BENJ. WELCH,

"GEO. HACKNEY,

"JNO. S. LENTZ,

"W. T. HILDROUP,

"D. H. NEALE,

"Committee."

The beneficial effect of the use of the electric valves was so marked that it apparently seemed to the committee to be the only direction in which to seek for the desired consummation, although it was the expressed opinion of many practical railroad men present that it would be a matter of great regret if necessity required the use of a new and untried agent such as electricity for the successful operation of brakes.

The results obtained with the new "quick-action" valve of the Westinghouse Company were in some respects extremely satisfactory and in others disappointing. The gain in the efficiency or the power to stop a train quickly was beyond expectation, as the average distance required to arrest the motion of a 50-car train running at the rate of 20 miles per hour was but 200 feet, as compared with 350 feet in the 1886 trials. I quote from the committee's 1887 report in the proceedings of the Master Car Builders' Association for 1887, as follows (pp. 165, 166):

"By reference to the journal of each day's work it will have been observed that the first four days were occupied by preliminary tests, such as engine tests, hand-brake tests, train-resistance tests, etc. The Westinghouse Brake Company, on the fifth morning of the tests, May 13, commenced the general tests with a 50-car empty train—three stops on level track, with their automatic air brake 50-empty-car train, resulting as follows:

50 Westinghouse Empty-car Train, 1887—Automatic Air Brakes.

No. of stop.	Speed in miles.	Distance in feet.	Shock in inches.	Time in seconds.	Equivalent distance at 20 miles and 40 miles.
521	19½	186	103	9½	196
511	19½	215	70½	11	233
522	36½	588	70½	17	693

"These stops may be regarded as phenomenal in their shortness which becomes all the more evident when we compare them with the best results obtained in 1886:

50 Westinghouse Empty-car Train, 1886—Automatic Air Brakes.

No. of stop.	Speed in miles.	Distance in feet.	Shock in inches.	Time in seconds.	Equivalent distance at 20 miles and 40 miles.	
621	23.5	424	Not taken.	17½	307	
611	20.3	354	" " "	16	340	
622	40	922	" " "	22½	922
612	40	927	" " "	22½	927

192 "The brilliancy of the record, however, was completely spoiled by the fearful shock given at the rear end, the slideometer moving, it will be observed, from 70 to 103 inches. The same train was then tested electrically, with the following results:

50 Westinghouse Empty-car Train, 1886—Electric Application.

No. of stop.	Speed in miles.	Distance in feet.	Shock in inches.	Time in seconds.	Equivalent distance at 20 miles and 40 miles.	
611	21½	160	None.....	7	139	
531	23	183	".....	8	138	
612	38	475	".....	14½	519
532	36½	460	".....	14	545

"Now comes the still more astonishing story. In these electrical stops the slideometer never moved, and this with the same cars, the same leverages and the same pressures, the only difference being the time of application. With the shocks the application commenced on the rear car in from five to six seconds; with the electrical application it was practically instantaneous on every car in the train.

"It will, perhaps, be necessary to compare the distances of these stops with other measurements to realize their full significance. Let us take the 138 and 139 feet of the 20-mile stops. Telegraph poles are generally spaced thirty-three to the mile, which allows a fraction of over 160 feet between each pole. The stops were, therefore, made in 22 feet less than the distance between two telegraph poles. Again, each of the Westinghouse cars measured 37 feet 8 inches from face to face of drawbar; 133 feet would therefore be, measuring in freight-car lengths, three car-lengths and 25 feet.

The hand-brake stop at the same point with the same cars was made in about five and one-half telegraph poles' length, or a fraction over twenty-three freight-car lengths. This hand-brake efficiency is much greater than generally found in service, on account of the difference in foundation gear."

That the shocks should have been so much greater when the interval between the application of the brakes upon the first and the last car had been reduced to less than six seconds, seemed in a measure paradoxical; but this was explained by the greatly increased efficiency of the brakes in the forward part of the train, as compared with those used in the 1886 trials, and this difference was largely due to the provisions made for realizing the maximum force in the brake-cylinder the instant of the operation of the triple-valve piston. By reference to the preceding portion of the testimony it will be found that a period of fully three seconds was required to obtain full power in this respect with the automatic brakes used in the 1886 trials.

The improvement in respect to the time of application between the first and last brakes was so great between the 1886 and 1887 trials that it was not generally believed by those conversant with the subject who witnessed the tests that a further change sufficiently great could be made to cause the quick-action apparatus to come within the prescribed requirements without the aid of electrical valves. To those, however, connected with the Westinghouse Air Brake Company, the great improvements that had already been made, and an unusual opportunity to appreciate the great importance of confining the operation of freight-train brakes to the use of a single element, were a sufficient incentive to further investigation and experiment. Upon the conclusion of the 1887 trials investigations were again commenced by them, by the direction and under the supervision of Geo. Westinghouse Jr., to determine the extreme possibilities of an approach to simultaneous action of all the brakes of a fifty-car train.

194 The cars upon which the trials in 1887 had been made were the property of the company, and arrangements were made with the C. B. & Q. Railroad Company for the use of locomotives and tracks to enable the experiments to be carried out under the same conditions and upon the identical ground that had been used in the 1886 and 1887 trials. The expense and labor connected with an investigation of this kind were very great, but our previous experience in shop experiments had clearly demonstrated that nothing less could be depended upon in a matter of so great importance.

As bearing upon the necessity for unusual effort that a prompt and accurate conclusion might be reached, it will be well to explain that, up to the time of the Master Car Builders' investigation, the use of power brakes upon freight trains had been confined to Western railroads. These companies operated roads having extremely heavy grades; the use of brakes in general service was almost constant; and a service was therefore had from them of considerably greater value than would be the case with roads more favorably located. Another important feature was the fact that, up to the time mentioned, there was but very little of what is known as "car interchange" upon these roads—that is to say, the cars belonging to the several companies rarely left their own lines, and

the necessity for identity of construction of car apparatus or anything pertaining thereto was limited.

The different conditions under which Eastern roads were operated probably accounts for their failure to accept the comparative success of the Western roads in the use of power brakes upon freight trains as sufficient reason for following their course. The conditions of trade, however, were constantly demanding increased speed and heavier trains, and the power of controlling these trains under the changed conditions was felt to be inadequate, and rapidly growing proportionately worse. That there was a great loss of life attendant upon the operation of hand brakes, due to the necessity of employees riding and moving upon the tops of trains in motion

was also revealed by carefully compiled statistics; so that

195 combined humanitarian and economic interests required that some action should be taken, leading to the general introduction of power brakes upon freight trains. It was in response to this sentiment that the Master Car Builders' Association made the investigations heretofore referred to; and the subject was of unusual importance in respect to the necessity of a decision that would be complete and final as to the principal characteristics of the apparatus to be used.

To accomplish the desired end, it was recognized as absolutely necessary that brake apparatus to be used on freight cars should be at least operatively uniform and interchangeable. Otherwise the great exchange or interchange of car equipment which is now common throughout the entire country would render an expenditure for brakes that would not intermingle and work together entirely wasteful and without beneficial result.

The conclusion of the 1887 trials, instead of furnishing to the railroads the desired information upon which to take prompt and reasonable action, seemed to show that much yet remained to be done before it could be safe to make a practical move in a matter of so great importance. These sentiments are clearly expressed in the committee's conclusion from the 1887 trials.

As up to this time the Westinghouse Air Brake Company had furnished nearly all the apparatus in use in the country, they were naturally in a position to receive reliable information as to the great desire of the leading railroads of the country for an immediate solution, if possible, of the problem as presented by the results of the 1887 trials. The general circumstances heretofore described were sufficient reasons for unusual effort and expense in carrying out our experimental work.

A careful analysis of the quick-action triple valve seemed to show that it possessed all of the qualities to be obtained through such a medium of actuation, and attention was therefore turned to the accessory portions, such as the train-pipe, hose and couplings—
196 and cocks—in fact all of the ordinary details of construction which in any manner influenced or controlled the flow of air in the apparatus. The ports of the quick-action triple valve were also enlarged, and with succeeding modifications of this nature

the interval of application between the first and last brakes on a train of fifty cars was reduced to two seconds.

In obtaining this maximum result the period of time from the middle of May, immediately after the completion of the 1887 trials, until the 1st of October was consumed. As may be imagined, the final result was not obtained at once, but by repeated steps which required the complete refitting of the 50-car train not less than three times. All the resources and employees that could be used were kept at work day and night without cessation, and the material for trial, each time involving more than a car-load, was conveyed from Pittsburgh to Burlington by express, so that no time might be lost. When finally, in the latter part of September, 1887, the last brake was applied in two seconds from the time of the movement of the valve by the engineer, the source of objectionable criticism that had heretofore existed against the use of compressed air, unaided by electricity, in the operation of power brakes upon long freight trains, disappeared, and the "quick-action automatic" brake, as then constructed and organized, became and has since been the standard power-brake apparatus for both freight and passenger trains.

A collateral advantage of considerable advantage, due entirely to the modifications made subsequent to the 1887 trials, was realized in an increased efficiency; and it was therefore found possible and desirable to considerably decrease the maximum brake-force, and still stop trains within the short distance realized in the 1887 trials. By this change in brake-force the liability to wheel-sliding was very greatly diminished.

The official character of the tests made by the Master Car Builders' Association, and the great interest taken in them by all railroad managers caused the results of the 1887 trials to be widely disseminated and discussed. The leading technical journals contained extended accounts of the experiments as they progressed, and commented upon and elaborated the information that was developed. Necessarily the conclusion of the investigating committee, previously quoted, which stated in terms that no satisfactory conclusion had been reached, was the important and controlling element of this widely spread information.

While the results of our experiments at Burlington were entirely successful, they were necessarily of an unofficial character, as there was no provision by which the Master Car Builders' Association were enabled to take part in them. It was therefore determined that in view of the great uncertainty existing in the minds of railroad men upon the subject, on account of the results of the Master Car Builders' tests, something more than a merely unofficial, and, what might possibly be regarded as a biased, account of the operations of our perfected apparatus should be given.

After careful consideration, it was determined that the best plan by which those interested could become fully and accurately informed would be to approximately repeat the Burlington experiments in as many of the large railroad centres as possible. In executing this arrangement, complete detailed tests were made in the

cities of St. Paul, Chicago, St. Louis, Cincinnati, Cleveland, Buffalo, Albany, Boston, New York, Philadelphia, Washington and Pittsburgh.

To do this it was necessary to convey the entire train of fifty cars, requiring two engines and sometimes three, from point to point; and this necessarily involved its operation under all the usual difficulties of regular traffic. In fact, the circumstances of its extreme length, it being nearly half a mile long, made its operation more than ordinarily difficult, as the train was conveyed over many roads upon which the grades usually limited the length of trains to a much smaller number of cars. The cost of this train, which was the property of the Westinghouse Air Brake Company, was 198 more than \$40,000, exclusive of the engines and the hotel car, which was required for the accommodation of those who accompanied the train to conduct its operations, and also to enable railroad men to observe the operations of the train in regular service. An expenditure of about \$15,000 was necessary to defray the expense of the journey, which occupied about six weeks and covered 5,000 miles.

At each point where demonstrations were made due notice was given to all railroad men and others interested in the subject, and nearly all of the leading managers accepted the invitation. The final exhibition of the train was made at Pittsburgh in November of 1887, and was the concluding act of a persistent and continuous development of the art of train-braking, carried on for a year with the utmost energy and at a total cost of probably not less than \$200,000.

Most gratifying evidence, however, of the value of the result obtained at such great cost was manifested by the receipt of large orders for the new quick-action brakes, immediately following the demonstrations of the exhibition train. In December of 1887, 822 sets were furnished. In the year 1888, 27,696 were supplied; in 1889, 26,065; and in 1890, 50,502. These were all applied to freight cars, and principally upon roads east of the Mississippi river, where, as previously stated, no material attempt had been made to use power-brake apparatus upon freight trains prior to the Burlington tests. The principal trunk lines, such as the New York Central and Pennsylvania systems, have adopted the quick-action brake as their standard, and it is being applied by them to all new cars, and to old cars requiring general repairs.

Previous to the Burlington trials the subject of legislation having in view the compulsory use of power brakes upon freight trains, on account of humanitarian considerations, was seriously considered, but the absence of practical devices rendered legislation on this subject impossible. Since the introduction of the quick-action 199 brake several of the State legislatures have enacted laws making the use of power brakes on freight trains compulsory; and the national legislature have had the subject before them for consideration.

The increased efficiency in train-stopping resulting from the improvements from the invention of the quick-action air brake has

also been realized in passenger-car brakes, and a passenger train can be stopped in a distance from 25 % to 40 % less with the quick-action brakes than when the prior "automatic" system was used. This important improvement has been taken advantage of by the principal railroads of the country, and most of the equipment has been changed from the old to the new type.

A final reference to the report of the Master Car Builders' Association will be found on pages 48 and 49 of the report of their proceedings for the year 1888. The complete report of the committee on freight-train brakes as there given is as follows:

"In our report to the convention last year the main conclusion we arrived at was that the best type of brake for freight service was one operated by air, and in which the valves were actuated by electricity. Since that time your committee has not made any further trial of brakes, but the aspect of the question has been much changed by the remarkable results achieved in non-official trials which have taken place in various parts of the country, and have been witnessed by many of the members of this association. These trials show that there is now a brake in the market which can be relied on as efficient in any condition of freight service.

"The present position of the freight-train brake is briefly as follows:

"First. Brakes can be, practically speaking, simultaneously applied without electricity throughout a train of fifty freight cars.

"Second. Other inventors are working at the problem of making an air brake which will be rapid in action and suitable for service on freight trains. We also understand that inventors are working at buffer and electric-friction brakes, but we have no reason to hope that brakes upon these principles can successfully compete with air brakes.

"In view of these conditions, your committee does not recommend the adoption of any particular brake, but considers that a freight-train brake should fulfill the following conditions:

"First. It shall work with air of seventy pounds pressure. A reduction of eight pounds shall set the brakes lightly, and a restoration of pressure shall release the brakes.

"Second. It shall work without shock on a train of fifty cars.

"Third. It shall stop a train of fifty empty freight cars when running at twenty miles per hour, within two hundred feet on a level.

"Fourth. When tried on a train of fifty cars, it shall maintain an even speed of fifteen miles an hour down a grade of fifty-three feet per mile without variation of more than five miles per hour above or below that speed at any time during the descent.

"Fifth. The brakes shall be capable of being applied, released and graduated on the whole train by the engine, or without any assistance from the brakemen or conductor.

"Sixth. The hose coupling shall couple with the present Westinghouse coupling.

"We recommend that all freight cars fitted with such a brake

shall be marked 'air brakes,' on each side of the car and near the top. The committee further recommends the use of iron or steel brake-beams, and that the subject of the best form and proportion of brake-gear, and the selection of a standard solid brake-shoe for use with metallic brake-beams, should be entrusted to a committee appointed for the purpose.

"(Signed)

G. W. RHODES.

"GEORGE HACKNEY.

"JOHN S. LENTZ.

"D. H. NEALE."

201 The non-official trials referred to in this report are those made by the exhibition train already described; and the full significance of these exhibitions could probably be indicated in no stronger manner than by the fact that, upon the presentation of the report of the committee just cited, they were discharged with the thanks of the association, after three years of arduous and painstaking investigation, and no further consideration of the subject has been made or found necessary by the association.

A concise statement of the differences in results obtained from the "automatic" apparatus made and used prior to 1886, as compared with the "quick-action" form as made subsequent to the latter part of 1887, and thenceforward, in regular practice, is as follows:

A train of 50 cars, when running at a speed of 20 miles per hour upon a level, required a distance of 350 feet to arrest its motion, with a braking force so great as to be dangerously near the point of wheel-sliding. The time of full application of the last brake upon the train was 12 seconds. The effect of an "emergency" application of the brakes under existing conditions caused a shock or collision upon the rear car, amounting to 49 inches, as measured by the slideometer; and this action was so objectionable that the use of power brakes under the stated conditions was decided to be impracticable.

A similar train fitted with the "quick-action" automatic brake apparatus, under the same conditions, is stopped in 200 feet, with a braking force limited to a point that renders it almost impossible to cause wheel-sliding. It also has the dual function of the use of auxiliary reservoir pressure alone for service stopping, and the combined power of auxiliary reservoir pressure and train-pipe pressure for "emergency" applications. The last brake in the train is applied within two seconds from the time of the movement of the engineer's valve; and there is no shock or collision sufficient to move the slideometer in the rear car.

The effect of these changes leads the Master Car Builders' committee to say that "there is now a brake in the market which can be relied on as efficient in any condition of freight service."

• A statement of the effect of the results obtained upon the standard practice in the use of power brakes on freight trains may be made as follows:

Prior to the introduction of the "quick-action" form of brake, air brakes were not used upon freight trains, except upon a few Western railroads with unusually heavy grades, operating trains of moderate length, and when there was but little interchange of freight cars with other railroads. In a period of seven years about 50,000 sets of brakes of the "automatic" brake system were supplied. There was no legislation suggesting or compelling the use of the power-brake apparatus upon freight trains.

Since the introduction of the "quick-action" form of brake, 125,000 sets have been furnished in a period of a little over three years, and these brakes have been principally furnished to the larger Eastern railroad systems, where their use has been made standard. And in several of the State legislatures the use of power-brake apparatus upon freight trains has been made obligatory.

H. HERMAN WESTINGHOUSE, SE.

HENRY B. STONE, being first duly cautioned, examined, and solemnly sworn, in answer to interrogatories to him propounded by Mr. Bell, deposes and says:

48 Q. What is your name, age, residence, and occupation?

A. Henry B. Stone; 39 years old; residence, Chicago; occupation, president of the Chicago Telephone Company and of the Central Union Telephone Company.

49 Q. What, if any, education and experience have you had in mechanical pursuits and in railroad service?

A. As a young man I learned the machinist's trade, and worked for several years in various machine shops and drafting-rooms, so that I am generally familiar with machinery. From 1878 to 1890

203 I was connected with the Chicago, Burlington and Quincy railroad in various capacities, beginning in the motive-power department, where, as master mechanic of a division of the road, and afterwards as superintendent of motive power of the whole road, I had charge of the machinery, including both engines and cars, with all their attachments. I was afterwards general superintendent and then general manager, and, at the time of my leaving in the spring of 1890, was the second vice-president.

50 Q. To what extent have you become familiar with the construction and operation of fluid-pressure brake mechanisms for railroads?

A. While superintendent of motive power and while general superintendent, I gave a great deal of personal attention to the matter of fluid-pressure brakes, and was personally familiar with the construction and operation of the various kinds used by the different railroads of this country.

51 Q. Will you please state briefly the characteristic and distinguishing feature of what are known in railroad practice as "quick-action automatic brakes?"

A. The ordinary air brake, fulfills very well, all the requirements of ordinary service in the handling of trains, that is to say, in making stops under usual conditions at stations, for switches, for water

tanks, and so on; but in cases of emergency, that is to say, when it is necessary to stop a train as quickly as possible to avoid disaster, the ordinary brake is not satisfactory, both because of its comparative slowness of action, but especially because of its causing severe shocks and breakages in long trains when suddenly applied. This latter difficulty arises from its not being simultaneous in its action, or nearly so, on all the cars in the train. In other words, the brakes would apply on the forward cars of the train an appreciable time before they applied on the rear cars, thus checking the forward end of the train to such an extent that the rear cars would run into them, causing serious results from the collision. To make this clear, I would explain that the combined slack of the springs and of the links, between ordinary freight cars, varies from six to twelve
 204 inches, so that in a train of fifty cars there is a slack of some twenty-five to fifty feet, dependent upon the character and condition of the couplings. The so-called "quick-action brakes" apply themselves practically simultaneously with full force on all the cars of the train, the result being that as each car has its own brake power applied at the same time as every other car, there is no tendency to collision. The "quick-action brakes" have the further very important advantage of effecting the stop in very considerably less time in the case of a long train than the ordinary brake, from the fact that the brakes are applied on every car practically instantaneously, whereas, with the ordinary brake in the case of a long train, the train often is nearly stopped before the brakes apply at all on the rear car. While the "quick-action brakes" have these advantages, which, in my opinion, are very great over the ordinary brakes, they perform all the functions of the ordinary brake for service stops in a manner equally satisfactory, and, in fact, entirely similar.

52 Q. When, and by whom, so far as your knowledge and information extend, were "quick-action automatic brakes" first introduced into practical service on railroads?

A. By the Westinghouse Air Brake Company, experimentally in 1887, and for practical use on trains in every-day service early in 1888.

53 Q. You were, at the period of their introduction, I understand from your previous testimony, an officer of the Chicago, Burlington and Quincy railroad?

A. I was; I was its general manager at that time.

54 Q. From your knowledge of the conditions and requirements of railroad service, please state to what extent you consider "quick-action automatic brakes" to be of importance and value therein.

A. I consider "quick-action automatic brakes" of the greatest importance in the operation of railways. In fact such brakes are a necessity for the successful, economical and safe handling of freight trains of the present day. I make this statement with reference to the so-called "quick-action automatic brakes" alone,
 205 the fact being that the ordinary automatic brakes, of the types in use prior to 1887, are not at all adequate, or even reasona-

bly satisfactory, in the operation of freight trains of the length common on the main trunk lines of the country.

55 Q. To what extent has the practical operation of "quick-action automatic brakes" since their introduction, been found to be useful and valuable, and to comply with the requirements for their production?

A. The "quick-action brakes" have completely fulfilled the requirements, and are being as rapidly applied by the principal railroads of the country as their finances will admit. At the time I left the C., B. & Q. road in the spring of 1890, the only question as to how many sets of these brakes should be applied in that year was how many we could pay for.

56 Q. Under what circumstances and in what manner were "quick-action automatic brakes" first experimentally tested in railroad service?

A. At Burlington, Iowa, on the tracks of the Chicago, Burlington and Quincy railroad, on a train of fifty freight cars belonging to the Westinghouse Air Brake Company; in making this statement I desire to be understood as meaning by "quick-action brakes," brakes actuated by air alone, there having been "quick-action brakes" actuated by a combination of electricity and air, shown at Burlington by other inventors earlier in the same year. These experiments at Burlington, to which I refer, were begun at the instance of the Master Car Builders' Association, and under the direction of a regularly appointed committee of its members. The first series of experiments took place at Burlington in the summer of 1886; the second series in the summer of 1887. It was in the fall of 1887, after the second series of experiments had demonstrated beyond question the necessity of a "quick-action brake," that the third series of experiments were made with the Westinghouse "quick-action automatic brake." This latter set of experiments was made under the same conditions in every respect, and on the same
206 tracks as the two preceding series, but were not under the official supervision of the Master Car Builders' committee, that committee having disbanded after the conclusion of the second series. The chairman of the committee, Mr. G. W. Rhodes, and, I think, one or two other members of the committee, were, however, present at the third series and gave the experiments the same personal, close supervision, as individuals, which they had given the other series of experiments as members of the Master Car Builders' committee.

57 Q. Subsequently to the several series of experiments at Burlington specified in your last answer, by whom and in what manner was the practical operation of "quick-action automatic brakes" in railroad service first publicly and successfully demonstrated?

A. By the Westinghouse Air Brake Company, who took the train of fifty cars, each equipped with a "quick-action automatic brake" and gave exhibitions—practical exhibitions of its operation, at Chicago and a large number of other railroad centres of the United States, their exhibition in each case consisting in making stops under the various conditions which occur in every-day practice,

including emergency stops, and stops where the brakes were automatically applied by the train "breaking in two," that is to say where the train separated, through a disconnection of the couplings, into two or more parts. I was personally present at the exhibition at Chicago, which was given on the tracks of the Chicago and Northwestern railway, a short distance out of the city; it was attended by a large number of railroad officers and also by very many locomotive engineers, who were present at the annual meeting of the Brotherhood of Locomotive Engineers, which happened to be sitting in Chicago at that time. The exhibition was an exhaustive one in the way of bringing out the features of the brakes, and all the tests made were entirely successful. I heard but one opinion expressed among the witnesses, which was that, in the familiar language of railroad men, the brake "filled the bill."

58 Q. Was the "quick-action brake," which was used by the Westinghouse Air Brake Company in the demonstrations
207 stated in your last preceding answer, the same as, or different from that which has since been and is now being made and applied by said company?

A. It was the same.

59 Q. In the report of the committee on freight-train brakes, on pages 48 and 49 of the Report of the Proceedings of the Master Car Builders' Association for 1888, I find the following language:

"Since that time your committee has not made any further trial of brakes, but the aspect of the question has been much changed by the remarkable results achieved in non-official trials which have taken place in various parts of the country, and have been witnessed by many of the members of this association. These trials show that there is now a brake in the market which can be relied on as efficient in any condition of freight service."

Can you state what brake is referred to in the foregoing quotation?

A. I was not a member of the committee referred to, but I have no doubt at all that the Westinghouse "quick-action automatic brake" is the one they referred to. In fact, there were no "non-official trials which had taken place in various parts of the country," except those of the Westinghouse Air Brake Company's train, to which I previously referred.

60 Q. Are you interested in any degree in the result of this suit?

A. I am not.

New York, July 18, 1891.

HENRY B. STONE.

GEO. H. CHRYSTY,
J. SNOWDEN BELL,
For Complainants.
LYSANDER HILL,
Of Counsel for Defendants.

208 United States Circuit Court, District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WEST-
INGHOUSE AIR BRAKE COMPANY

vs.

BOYDEN POWER BRAKE COMPANY; CHARLES
A. Boyden, President; Charles B. Mann, Sec-
retary, and William Whitridge, Treasurer.

In Equity. No. 321.

Deposition of H. Herman Westinghouse in cross-examination, and other evidence on behalf of complainants in above-entitled cause, under the 67th rule in equity as amended, pursuant to stipulation heretofore made in this cause and to agreement of counsel, formal notice being waived, before Wm. H. Masson, notary public, as agreed special examiner, at the office of O. Milton Dennis, 23 Chamber of Commerce building, Baltimore, Maryland, commencing on Tuesday, August 18th, 1891, at 10.30 a. m.

Present: J. Snowden Bell, Esq., of counsel for complainants, and Charles B. Mann, Esq., on behalf of defendants.

It is stipulated and agreed that the testimony may be taken by W. H. Masson, notary public, as special examiner, with the same force and effect as before a standing examiner of the court or a special examiner duly appointed and that an order to such effect may be entered *nunc pro tunc* at or before the hearing.

209 H. HERMAN WESTINGHOUSE, being produced for cross-examination in accordance with stipulation, deposes and says, in answer to cross-interrogatories propounded to him by Charles B. Mann, Esq., on behalf of defendants as follows, to wit:

115 X Q. I understand you to state that you have been connected with the Westinghouse Air Brake Company since the year 1872, and that your experience during the past 19 years has made you entirely familiar with the construction and mode of operation of automatic air-brake mechanism for railroads; is this correct?

A. It is.

116 X Q. I also understand you to state that you are familiar with all the experiments and trials that led to the invention and adoption of the quick-action triple valve for air brakes now so largely in use; is this correct?

A. It is.

117 X Q. The triple valve made and sold by the Westinghouse Air Brake Company, and shown in plate D 20 of the Westinghouse 1890 catalogue, is the form in which the invention shown in Mr. Westinghouse's patent No. 220,556, dated October 14, 1879, was put in use by said company, is it not?

Objected to as incompetent, the witness not having been shown to be familiar with the patent referred to, or to be capable of rendering opinions as to the similarity or difference between structures and letters patent.

The question is further objected to as not proper cross-examination, the witness not having testified in chief as to the letters patent inquired about, and his deposition-in-chief relating wholly to matters of fact and not to opinions as to any questions whatever.

A. I have made no attempt to identify the construction of our brake mechanism with our patents, such matters having always been referred to our counsel.

210 113 X Q. Do you wish to be understood as meaning that you are unable to say from your knowledge of these matters whether or not the triple valve shown in plate D 20 of the 1890 catalogue is the form of valve patented to Mr. George Westinghouse, Jr., October 14, 1879?

Same objection, which is continued without further notice as to this entire line of examination as to matters not touched upon in the witness' deposition-in-chief, and to save unnecessary delay, the witness is instructed that he is not obligated to answer any questions as to matters not touched upon, directly or indirectly, in his deposition-in-chief, or as to any matters regarding which he does not feel himself competent or willing to express an opinion.

A. In my direct examination I have not referred at all to the subject of patents, and as an answer to the question involves expressions of opinions upon points upon which I have heretofore made no statements, I do not care to further answer the question.

119 X Q. Did the Westinghouse Air Brake Co. put into use the form of triple valve shown in plate D 20 of the Westinghouse 1890 catalogue during the eight years between 1879 and 1887?

A. It did.

120 X Q. State whether or not, during that period, all of the Westinghouse triple valves for car service were made in that form, and, if not, what proportion of them were made in that form.

A. They were not all made in the form shown on plate D 20, and without being able to state accurately, I should say that probably about one-third of our product was of the kind mentioned between those years.

121 X Q. Will you please indicate, by reference to the plate in the Westinghouse 1890 catalogue, what form of triple valve was employed for the other two-thirds of the valves made during that period?

211 A. The other form of triple valve is not illustrated in the 1890 catalogue, to which I have heretofore referred. I have no copy of the 1886 catalogue here, in which it is illustrated.

122 X Q. I understand you to have stated that you are entirely familiar with the construction and mode of operation of the various triple valves made and sold by the Westinghouse Air Brake Co.; now, I desire to ask you, with reference to the triple valve shown in plate D 20 in the 1890 catalogue, whether it is not a fact that when making a "graduating" application of the brakes with that form of triple valve, it was intended to let the air flow from the aux-

iliary reservoir to the brake-cylinder only by the small passage through the main valve controlled by the small valve?

A. When making a "graduating" application of the brake, it was intended that the air should pass from the auxiliary reservoir to the cylinder through the opening controlled by the small valve.

123 X Q. You have stated that automatic brakes, when using triple valves of this form, perform all the usual operations of braking known as "service stops" in an entirely satisfactory manner; you then go on to refer to the unsatisfactory manner in which this form of valve made "emergency stops." I now desire to ask you how the "emergency stops" with that old form of valve were made?

A. By exhausting air as rapidly as possible from the train-pipe on the locomotive.

124 X Q. State what action this exhaustion of air produced on the triple valve whereby it made the "emergency stops"?

A. It reduced the pressure on the train-pipe side of the triple-valve piston as rapidly as possible, with the mode of operation as described in the answer to the previous question.

This results in the quickest movement of the valve controlling communication between the auxiliary reservoir and the brake-cylinder, and also makes the largest port opening for the flow of air pressure to the brake-cylinder that is possible in connection with limiting conditions.

125 X Q. This making of the largest port opening allows the air to flow from the auxiliary reservoir to the brake-cylinder more freely and quickly than is possible when the small "graduating" valve alone is open, does it not?

A. The largest possible port opening may be considerably less than the one controlled by the small "graduating" valve.

126 X Q. Well, as a matter of fact as used in practice, is not the port of the "graduating" valve smaller than the largest port opening you have referred to?

A. In the majority of the triple valves we have made between the years 1879 and 1887, there is but one port leading from the auxiliary reservoir to the brake-cylinder and this is controlled by the "graduating" valve.

127 X Q. Is the triple valve shown in the plate D 20 in the 1890 catalogue, one of the kind which has but one port leading from the auxiliary reservoir to the brake-cylinder, and which port is controlled by the "graduating" valve?

A. It is not. The valve has a single opening leading from the auxiliary reservoir to the brake-cylinder controlled by the graduating valve and also by a portion of the slide-valve.

128 X Q. Is not the port of the "graduating" valve shown in plate D 20 smaller than the port formed in the casing of the valve which is controlled by a portion of the slide-valve?

A. It is.

129 X Q. And in order to serve the purpose of an "emergency stop" with any degree of satisfaction, is it not necessary that the

port which is referred to in the last question as being in the casing, should be larger than the "graduating" port?

A. It is not necessary that it should be larger.

130 X Q. Why?

A. Because there is no reason why the port controlled by the "graduating" valve should not be as large as the one leading through the valve casing from the auxiliary reservoir to the brake-cylinder.

213 131 X Q. Will not a larger port allow the air to pass from the auxiliary reservoir to the brake-cylinder more freely and quickly than a small one?

A. It will, provided the port is unobstructed.

132 X Q. I take it that when, in your examination-in-chief, you referred to "service stops" and "emergency stops" as made by the triple valve in use prior to the year 1887, the port through which air passed to the brake-cylinder when making "emergency stops" was larger than the port of the "graduating" valve; am I right or not?

A. My testimony was of a general nature, and did not refer to specific constructions, but as previously stated, the majority of our triple valves had but a single port controlled by the "graduating" valve.

I therefore did not have in mind the opening of a larger port for emergency purposes.

133 X Q. I now understand from an explanation which you have made, not on the record, that the majority of triple valves used prior to the year 1887 were on freight cars, and such valve had but a single port controlled by the "graduating" valve. I also understand that triple valves made like that shown in plate D 20 of the catalogue of 1890 were used on passenger cars, and that such valves had a port through which air passed to the brake-cylinder, when making "emergency stops," that was larger than the port of the "graduating" valve; is this correct?

A. Your understanding of the matter is substantially correct.

Mr. Mann states: I may hereafter ask you to designate on the Westinghouse catalogue of 1886, the plate which shows the style of triple valve used on freight cars to which you have referred.

134 X Q. You have stated that the improved operation known as "quick action," is obtained by an addition to the mechanism of the triple valve, as shown in plates D 1, D 22, D 26, D 31 of the Westinghouse catalogue of 1890; such "addition" comprises the direct passage from the drain-cup of the valve case to the brake-cylinder, and the auxiliary valve controlling that passage, does it not?

A. There is a direct passage from the drain-cup or train-pipe to the brake-cylinder, controlled by an auxiliary valve, and these are comprised and are an addition in the improved "quick-action" triple valve relatively to the old triple valve.

135 X Q. I now have a copy of the Westinghouse catalogue of 1886; will you please designate in the catalogue the plate of the

triple valve which you have stated was used on freight cars prior to the year 1887?

A. Plate B 25 is the one which illustrates this triple valve.

136 X Q. When was the "quick-action" triple valve shown in plates D 1, D 22, D 26, and D 31, adopted by the Westinghouse Air Brake Co.?

A. This valve was adopted by them about December, 1887.

137 X Q. Is this the valve that was patented January 24th, 1888, No. 376,837?

Objected to as incompetent, the witness not having been shown to be familiar with the patent referred to, or to be capable of rendering opinions as to the similarity or difference between structures and letters patent.

The question is one of law for the court, and not proper or competent for the witness to pass upon.

The question is further objected to as not proper cross-examination, the witness not having testified in chief as to the letters patent inquired about, and his testimony-in-chief relating wholly to matters of fact.

Answer is made that the question relates strictly to a matter of fact which is doubtless within the knowledge of the witness. The question does not call for the expression of opinion as to the similarity or difference between structures or letters patent.

Counsel for complainant replies that the question of what is patented in and by the letters patent referred to, or any other letters patent, is a question of law pure and simple, and is not, therefore, a proper question for the witness to answer, being one for the determination of the court. The structure referred to in the question is before the court, of record, and counsel for defendants can, if he desires, offer in evidence the patent about which he inquires, and, at the hearing, obtain the court's opinion as to the identity or difference of said structure and of said patent, offering, if he deems proper, such testimony on behalf of defendants as may serve to support whatever view in the case he adopts and believes to be the correct one. He cannot, however, use this witness in support of his views upon this, or any other question of law, and without consuming further time in argument upon the record, the witness is instructed that he is not obligated to answer this or any other question calling for his opinion upon a matter of law.

138 X Q. State whether or not the quick-action triple valve which you say was adopted by the Westinghouse Co. about December, 1887, and which is shown in plates D 1, D 22, D 26, D 31 of the 1890 catalogue has been patented?

Same objection, which is continued without further notice as to the entire line of examination relating to letters patent, the identification of structures therewith, or the comparison of letters patent one with another, or with a structure or structures.

216 A. I have made no attempt to identify patents taken or owned by our company with the construction of apparatus.

The answer is objected to because it is not responsive and witness' attention is called to the fact.

(Witness continues:) The answer is as responsive as the knowledge I have justifies me in making.

139 X Q. You are general manager of the Westinghouse Air Brake Co. and I believe you have had much to do with such matters as relate to newly patented improvements on various parts of the air-brake system, and with such matters as the purchase of patents relating to such new improvements. In view of this I now ask you if you have not often seen and examined copies of patents belonging to the Westinghouse Air Brake Co. relating to quick-action triple valves?

Same objection, and further objected to as immaterial.

A. As general manager of the company I have had less to do with the patent matters connected with our operations than any other department of our business. I have seen and examined patents relating to quick-action brakes.

140 X Q. Are you not aware that the quick-action triple valve made by your company bear the mark of two patents, to wit, March 29th, 1887, and January 24th, 1888?

A. I am not aware that that is the fact.

141 X Q. Please state what are the facts with regard to the patent marks on the quick-action triple valves made and sold by your company?

A. I do not know the facts connected with marks on the quick-action triple valves made and sold by our company.

142 X Q. I understand that you do not deny that the date of January 24th, 1888, is the correct date of the patent on the quick-action triple valve now in use by your company, and which was adopted by them about December, 1887, but only that you cannot state whether that date is on the triple valves that are made and sold, am I right?

Same objection, the question being merely a paraphrase of that, to wit, cross-question No. 137, with which counsel began his inquiry upon the question of the identity of structures with patents.

A. I do not deny it, for the reasons previously stated. I am absolutely ignorant of what marks, patent or otherwise, are upon our triple valves.

143 X Q. What quick-action triple valve did you refer to in your examination-in-chief as being one which the Westinghouse Air Brake Company, since December, 1887, has furnished to railroads for car service, substantially to the exclusion of all others?

A. The one illustrated on plate D 22 of our 1890 catalogue.

144 X Q. You stated that about 125,000 quick-action triple valves

are now in general use; please state what valves are here referred to?

A. The valve referred to on plate D 22 of our 1890 catalogue.

145 X Q. Did you make the affidavit to the bill of complaint in this suit?

A. I did.

146 X Q. That bill of complaint sets up a charge of infringement as to letters patent of March 29th, 1887, No. 360,070, does it not?

Objected to, first, as not being proper cross-examination, having no reference whatever to the witness' deposition-in-chief, and, second, as calling for secondary evidence, the bill of complaint being the best evidence, and the same being before the court, and the witness not being competent to explain or construe such written instrument.

218 Answer is made that the witness is not asked, and will not be asked, to explain or construe any of the allegations set forth in the bill of complaint. He is asked a simple question, which certainly is within his knowledge.

Counsel for complainants repeats that the bill of complaint, of record, is the best evidence, and that the witness is not competent to state what it "sets up," that matter being, like the remainder of the pleadings, one for the consideration and determination of the court.

A. I don't remember whether it does or not.

147 X Q. Do I understand you to mean that although you are so largely interested in the matters involved in this suit, yet you do not know anything about what patent is sued on in this suit; is this so?

Same objection, and the witness is requested to refrain from expressing any opinion as to his understanding of the pleadings in this cause or any other matter of law connected therewith or relating thereto. What the bill sets up, and every other matter pleaded, is of record, and will be determined by the court much better than it can be by the witness, and in accordance with the rules of law governing such questions.

Answer is made that the question involved an inquiry simply as to what the witness knew, and did not call for any expression of opinion as to the pleadings in this cause.

A. I simply mean to state that I have not specifically charged my mind with details connected with this suit which have been referred to by counsel, and I am therefore unable to speak accurately and definitely upon the point in question.

148 X Q. You have testified in regard to the tests of air brakes that were made at Burlington, Iowa, in the years 1886 and 1887,

and you have stated that you are familiar with all the experiments which led up to the adoption of the quick-action triple valve now in general use. I now ask you if, after the Burlington tests of 1886, which developed the inability of the old triple valve to prevent severe shock in long trains, Mr. George Westing-

house, Jr., set to work to overcome that defect, and what was the first quick-action triple valve that he produced in his effort in that direction?

A. After the Burlington tests of 1886, Mr. George Westinghouse, Jr., did commence experiments to overcome defects developed in the preceding brake trials. The first form of quick-action triple valve is illustrated in the blue-print drawing No. 2681, which I here present.

The blue print referred to by the witness is here offered and put in evidence, and is marked "Complainants' Exhibit Blue Print, First Form of Quick-action Triple Valve."

149 X Q. I observe, by a comparison of the valve shown on this blue print with the valve shown in letters patent 360,970, March 29th, 1887, to George Westinghouse, Jr., that the said blue-print valve is the same as that shown in the patent referred to, which is the patent in suit. I now ask you if this is in accord with your understanding of the matter?

Same objection as heretofore entered relatively to the incompetency of questions calling for a comparison of structures with letters patent. Both the patent and the blue print are in evidence, and defendants' counsel can, if he deems it necessary or desirable so to do, adduce the testimony of a witness expert in such comparisons on behalf of defendants.

The question is also objected to because the assumption contained in the first sentence thereof makes defendants' counsel a witness.

Answer is made that whether the assumption in the first part of the question makes me a witness or not can be a matter of no consequence, since the simple question to the witness is, as to whether what is stated is in accord with his understanding of the matter. If it is not in accord with his understanding the witness can say so, and if it is in accord with his understanding why certainly he can say so, and now I leave the matter with the witness.

A. I have made no comparison of the patent drawings mentioned and the blue print in evidence, and, as heretofore stated, I do not care to take up the question of relation of patents to structures.

150 X Q. I have not asked you nor will I ask you to take up the question of the relation of patents to structures. I supposed that I was asking you a simple question that you fully understood. I will now ask you if you have not testified that you were at one time in the draughting department of the Westinghouse Air Brake Co., and whether you consider yourself, notwithstanding your experience in such matters, incompetent to pass on so simple a matter as the comparison of two drawings with which you are already familiar?

A. I was formerly in the draughting-room of the Westinghouse Air Brake Company, and, so far as I can remember, there is nothing in my testimony indicating my inability or unwillingness to

made a comparison between drawings. In a former answer I simply stated that I had not made the comparison you asked for.

151 X Q. Then, as I now understand that you do consider yourself competent to compare the valve shown in the blue-print drawing with the valve shown in the drawings of letters patent No. 360,070, which is in suit, and to state whether or not they are substantially the same, I will therefore ask you to make such comparison, and state whether or not they are the same?

A. So far as I can discover, the drawing represents substantially the same construction.

152 X Q. Then, I understand that the first form of quick-action triple valve which was gotten up by Mr. George

Westinghouse, Jr., after the Burlington test of 1886, is shown in the drawings of patent 360,070?

A. It is.

153 X Q. Will you now please state whether or not quick-action triple valves made like that shown in the drawings of patent 360,070 were tried on a fifty-car train at the second test in 1887 at Burlington?

A. Valves of the general form of the kind indicated were used at the time stated, but I am not sure as to the exact identity of the construction of the valves there used and the drawings heretofore mentioned. They were however substantially of the construction shown in the patent drawing.

154 X Q. Were the valves tried at the second Burlington test which you say were substantially like the drawings of patent 360,070, painted red?

A. Possibly they were, but I cannot speak definitely on this point.

155 X Q. I understand you to state that the result of the May, 1887, Burlington test of these valves was that there was greater and more severe shock on the rear cars than there was with the old-style triple valve that was tried in the test of 1886, is this correct?

A. It is true that the general organization of the brake-equipment of the 1887 trials produced greater shocks than were experienced in the 1886 trials.

156 X Q. Upon the conclusion of the second brake-trials in May, 1887, where the Westinghouse train was equipped with triple valves made like the drawings of patent in suit, No. 360,070, I understand the committee of master car-builders decided that although the Westinghouse train made stops in a less time and a shorter distance than in the year 1886, yet this record "was completely spoiled by the fearful shocks given at the rear end," is this correct?

A. That was the opinion expressed by the committee, with which I do not coincide.

Adjourned to meet tomorrow Wednesday, August 19th, at 10.30 a. m.

AUGUST 19TH, 1891.

Met pursuant to adjournment.

Present: As before.

Cross-examination of H. HERMAN WESTINGHOUSE continued:

157 X Q. Did you not state in your examination-in-chief, in regard to the second brake-trials at Burlington, May, 1887, with the train of the Westinghouse Co. having valves substantially like the drawings of the patent in suit No. 360,070, that in making "emergency stops" "the shocks experienced in the preceding year were greatly exceeded, reaching a maximum of 103 inches (by the slide-meter), as compared with the maximum of 49 inches in the 1886 trial. *In fact, they were so severe that it was not deemed prudent to use the brake in 'emergency' applications without the use of the electrical valves?*"

A. I believe that my testimony is substantially in accordance with the statement you have made.

158 X Q. At the second Burlington test, made May, 1887, a train of fifty cars was tried, equipped with valves substantially like that of the drawings of the patent in suit No. 360,070, and in regard to this you stated, "the conclusion of the 1887 trials, instead of furnishing to the railroads the desired information upon which to take prompt and reasonable action, seemed to show that much yet remained to be done before it could be safe to make a practical movement in a matter of so great importance." Is this correct?

A. The quotation is substantially correct.

159 X Q. I understand from your testimony, that upon the conclusion of the 1887 trials at Burlington, persons connected with the Westinghouse Co. "*again commenced*" investigation by the direction and under the supervision of George Westinghouse, Jr., with the object in view of providing means to produce more satisfactory results in quick action of brakes on a fifty-car train. Is this correct?

223 A. It is.

160 X Q. I understand you to state, in substance, that the period of time between the conclusion of the 1887 trial (May) and the latter part of September, 1887, was consumed by a force of employees of your company, under the supervision of George Westinghouse, Jr., in experiments to get improved results, and at the end of that time they succeeded in obtaining a newly constructed and differently organized quick-action triple valve that was satisfactory. Is this correct?

A. I do not remember having testified to the facts as stated.

161 X Q. Please to take up the question 160 last asked, commencing with the first statement made therein, and point out to me what statements are correct and what are incorrect?

A. The first statement in the question relating to experiments having been made between the period May, 1887, and latter part of September, 1887, under the direction of Mr. George Westinghouse, Jr., for the purpose of obtaining improved results, is substantially in accordance with my testimony and is correct.

The second statement in the question, that at "the end of that time they succeeded in obtaining a newly constructed and differently organized quick-action valve that was satisfactory," I do not remember to have heretofore made, but the statement is substantially correct.

162 X Q. Please designate on the Westinghouse catalogue of 1890, if it is there illustrated, the triple valve which was satisfactory and which was obtained about the latter part of September, 1887?

A. The catalogue of 1890 contains but one of the triple valves that were found to be satisfactory at the conclusion of the experiments in September, 1887, and one of the satisfactory ones is illustrated on plate D 22 of the 1890 catalogue, also in plates D 26 and D 31.

163 X Q. Please look at the drawings of patent No. 376,837, dated January 24th, 1888, and state whether the quick-action triple valve there shown is the one that was developed at Burlington between May, 1887, and the latter part of September, 1887?

224 A. Yes, it is.

164 X Q. And this valve shown in the drawing of patent 376,837 was thereupon, about December, 1887, adopted by the Westinghouse Co. as its standard form of quick-action triple valve, and has been continued in use as such ever since; is not this the fact?

A. The construction of the valve indicated was adopted as the standard about December, 1887, and has continued substantially the standard ever since.

165 X Q. Does the Westinghouse catalogue 1890, the one now in use, contain any plates or illustrations of "quick-action triple valves" like that shown in the drawings of the letters patent No. 360,070?

A. It does not.

166 X Q. Please state whether or not the type or form of "quick-action triple valve" which is shown in the drawings of the patent No. 360,070 was ever illustrated in any catalogue issued by the Westinghouse Air Brake Company?

A. I believe it was not.

167 X Q. Is the Westinghouse Air Brake Company now making and selling "quick-action triple valves" of the type or form shown in the drawings of the letters patent No. 360,070?

A. They are not.

168 X Q. Are any "quick-action triple valves" like that shown in the drawings of the patent No. 360,070 now in regular use on railroads; if yea, state where?

A. Valves of the kind indicated are now in use on the Atchison, Topeka and Santa Fé R. R.

169 X Q. State how many of such valves are in use on that railroad?

A. While I have not accurate information on that point, to the best of my knowledge the number is between 1,500 and 1,800.

170 X Q. I understand you to say that the Atchison, Topeka and Santa Fé railroad now has from 1,500 to 1,800 "quick-action triple valves" made like that shown in the drawings of patent 360,070;

now please state when these valves were sold and delivered to that company?

225 A. During the year 1887, but prior to the month of December.

171 X Q. What kind of cars are those valves on?

A. Freight cars.

172 X Q. Then I understand from your testimony that although the valves that we are now discussing, made like the drawings of patent No. 360,070, produced severe shocks on long trains at the Burlington test, which shocks were so severe that it was admitted by the committee in charge of the test, and admitted by yourself, where you stated "that it was not deemed prudent to use the brake in emergency applications without the use of the electrical valve," yet, notwithstanding this impracticable aspect of the matter, yet the Atchison, Topeka and Santa Fé railroad have continued to use those valves until the present time; is this correct?

This question is objected to as argumentative and improper in form, and further as misleading, in assuming conclusions not stated in or warranted by the witness' deposition-in-chief, or thus far in cross-examination.

Counsel for defendants now requests counsel for complainants to distinctly point out in cross-question No. 172 anything that is misleading in that it assumes conclusions not stated in the deposition of the witness or in his cross-examination.

In compliance with the request of counsel for defendants, counsel for complainants points out that the question is misleading in that it assumes that the witness has stated that "the valves that we are now discussing made like the drawings of patent No. 360,070" produced severe shocks on long trains at the Burlington test while, as a matter of fact, the witness has made no such statement as to the valves. He has admitted that severe shocks were experienced at the Burlington test, but he has not said anywhere that such
226 shocks were due to, or were produced by, the valves that we are now discussing, or by valves made like the drawings of patent No. 360,070. Further, he has not said anything which warrants the use of the term "impracticable" in the question, such term being applied, as counsel understands it, to the valves referred to in the question.

Counsel for defendants rejoins and says that a large part of the testimony of the witness has related to explanations about the valves used in the tests at Burlington in 1887—valves like the drawings in patent No. 360,070, and to shocks that were produced on the cars when those valves were used.

He also distinctly attributed those shocks to the action of the valves.

Further, his own testimony, and quotations he gives in his testimony from the report of the car-builders' committee, show that a triple valve, which produced or gave rise to such "shocks" as were made at Burlington when the valves in question were tried, would be impracticable for railroads on long trains. To show what the

witness has stated with reference to these valves. I will make a few quotations from the long statement which he made in his examination-in-chief.

"The discharge port from the auxiliary valve was, therefore, connected with the brake-cylinder instead of leading it to the atmosphere. The effect of this modification was to cause a considerable amount of the pressure in the train-pipe to pass into the brake-cylinder, where it contributed to that regularly supplied by the auxiliary reservoir, augmenting the brake force fully twenty per cent. in emergency or quick applications."

"Provision was made whereby the benefits of the improvements were applicable to the automatic apparatus already in use. This was accomplished by a form of valve mechanism entirely
227 independent of the triple valve of the automatic system, and arranged to control communication between the brake-pipe and the brake-cylinder."

"By the improvements described in triple-valve construction, the interval of applications between the first and last cars of the test train was reduced from twelve to six seconds."

I now give a quotation found in Mr. Westinghouse's testimony, which he quotes from the report of the car-builders' committee: "The Westinghouse Brake Company, unwilling to accept as final their May, 1887, record, is making changes in valves and piping, by which they hope to make short fifty-car emergency stops, without objectional shocks and without the aid of electricity."

I now quote from the testimony of Mr. Westinghouse:

"The results obtained with the new quick-action valve (the one tried in May, 1887) of the Westinghouse Company were, in some respects, extremely satisfactory and in others disappointing."

I now quote from the committee of car-builders as given by Mr. Westinghouse:

"Now comes the still more astonishing story. In these electrical stops the slideometer never moved, and this with the same cars, the same leverages, and the same pressures, the only difference being the time of application."

Counsel for complainants, submitting to the court that the above quotations made by counsel for defendants wholly fail to justify his inferences therefrom, and his assumption in the question that "the valves we are now discussing" produced the severe shocks at the Burlington test, deems it unnecessary to argue the matter further on the record.

A. I have not intended to testify that the form of valve
228 under discussion, that was used in the 1887 trials, was the cause of the objectionable shocks that were produced in the trains upon which those valves were used. I had intended to be understood that with the entire brake-equipment organized in the manner used upon the train in question, that their general operation was unsatisfactory, when used under the conditions that existed when the trials were made. As a matter of fact, these valves, when provided with the proper accessories, such as are now fur-

nished with brakes sold by us, performed in an entirely satisfactory manner. The shocks in a fifty-car train, equipped with these valves and proper accessories, was less than what was experienced in the 1886 trials. By enlarging the passages controlling the flow of air direct from the train-pipe to the cylinder, and without any modification or departure from the principle or form of construction shown in drawings of patent 360,070, results identical with those produced by the valves shown on plate D 22 of 1890 catalogue were obtained.

In view of these facts it is manifestly untrue that the form of valves used in the May, 1887, trials at Burlington was responsible for the objectionable shocks.

173 X Q. I believe you have nowhere testified heretofore that the enlargement of the passages of the valve in question through which the air flowed direct from the train-pipe to the brake-cylinder produced satisfactory results in the tests made at Burlington in May, 1887, have you?

A. I have not, and do not now intend to convey the impression that these enlargements were made during the May, 1887, master car-builders' brake trials.

174 X Q. Does not your testimony contain the statement substantially that at Burlington, in May, 1887, when valves like those in the drawings of patent No. 360,070 were used without the electrical attachment, such shocks were produced; "that it was not deemed prudent to use the brake in emergency applications," but when the electrical attachment was used, with the same valves and the same equipment otherwise, there was no shock and the slide-meter did not move; is not this so?

229 A. I have testified substantially to that effect, but wish to explain that the electrical attachments spoken of are not a portion of the triple-valve mechanism, and had no direct connection with the triple valves. They were located in the train-pipe at about the fifteenth and twenty-fifth cars. Their mode of operation was to cause an opening in the train-pipe coincident with the operation of the engineer's valve, and thereby aided reduction of pressure in the train-pipe.

175 X Q. Then I understand from your testimony that the effect of the electrical attachment referred to, was to so accelerate the reduction of pressure in the train-pipe that the triple valves, with this assistance, were able to make a stop without shock; is this correct?

A. Your understanding of the matter is substantially correct, and with the same systems ordinary triple valves would produce stops without shock.

176 X Q. I understand that the valves with which the electrical attachment was used at the time referred to were like the valves shown in the drawing of patent No. 360,070; is this correct?

A. It is.

177 X Q. The defendants have in their possession a valve which you sent to the Boyden Company in exchange for one of theirs, and

I ask you if that valve which you sent to them is like the valves that were used in the May, 1887, Burlington trials?

A. I do not know, but I presume it is, as it was our intention to send a valve of that kind.

178 X Q. Please look at the drawing of the patent No. 393,784, dated December 4th, 1888, to Harvey S. Park, and state whether or not it shows a quick-action triple valve, and whether said patent belongs to the Westinghouse Air Brake Co.?

Objected to as not proper cross-examination, and further as immaterial.

A. The drawing shows a form of valve that, properly constructed, will be of a quick-action type, and the patent is the property of the Westinghouse Air Brake Co.?

179 X Q. I understand that the Westinghouse Air Brake Co. owns three types or forms of quick-action triple valves, to wit, that like the drawings of patent No. 360,070; that like the drawings of patent No. 376,837, and that like the drawings of patent No. 393,874. Is this correct?

A. It is.

180 X Q. Do you not consider that the quick-action triple valves shown in the drawings of each of the three patents just named is for the purpose of accomplishing the same result?

A. I do.

181 X Q. The drawings of said three patents show three distinct and different ways of accomplishing the quick-action result in automatic air brakes, do they not?

A. I regard the method of accomplishing quick action in air brakes as the same in each case, but different mechanical devices are employed in each instance.

182 X Q. I will state briefly my understanding of the operation of the valve described in each of the three patents. In patent No. 360,070 the valve which controls communication direct between the train-pipe and the cylinder is opened by means of the triple-valve piston acting mechanically upon it; in patent No. 376,837 this valve is opened by auxiliary reservoir pressure acting independently of the mechanical action of the triple-valve piston, and in patent No. 393,784 this valve is opened by train-pipe pressure acting directly on it. Is this statement correct?

A. So far as the operations described are concerned I regard it as substantially correct.

183 X Q. Inasmuch as there are now three types of "quick-action triple valves" to which reference has been made in the last few questions, for automatic air brakes, I would ask you do you think it impossible for a fourth type of this class of valves to be devised?

A. I do not.

231 184 X Q. Did you make the affidavit to the bill of complaint in the two equity suits now pending in the circuit court of the United States for the southern district of New York, where the Westinghouse Air Brake Company sues the New York Air Brake Company for an alleged infringement, among other

things, of two patents relating to quick-action triple valves, one being patent dated January 24th, 1888, No. 376,837, issued to George Westinghouse, Jr., and the other patent dated December 4th, 1888, No. 393,784, issued to Harvey S. Park; and is it not the fact that patent No. 360,070 in this suit is not included in the bills of complaint in the New York suits?

Objected to as not proper cross-examination and as immaterial.

A. I did, and as I am advised that patent 360,070 was not included in either of the New York suits, I will admit such to be the fact.

It is hereby stipulated and agreed that copies of the 1886 and 1890 catalogue of the Westinghouse Air Brake Company may be referred to at the hearing by either party with the same force and effect as if the same had been formally offered in evidence.

Redirect examination by J. SNOWDEN BELL, Esq., of counsel for complainants:

185 Q. Please state in what manner automatic air-brake apparatus manufactured and sold by the Westinghouse Air Brake Company is marked for the purpose of indicating letters patent under or in accordance with which such apparatus is made.

A. By instruction of counsel we have prepared a plate bearing dates of various patents owned or controlled by the Westinghouse Air Brake Company, under which their apparatus is made, and this plate is attached to the air pump of the locomotive where it is plainly visible.

232 186 Q. By whom or under whose direction are the several dates of patents placed upon this plate?

A. By direction of the company's counsel.

187 Q. Is the determination of questions relating to letters patent any part of your duty as general manager of the Westinghouse Air Brake Company, and, if not, to whom are such questions referred, and by whom are they determined?

A. It is not a part of my duty, and such matters are referred to and determined by the company's counsel.

188 Q. You have stated in your answer to cross-question 162 that your company's catalogue of 1890 contains but one of the triple valves that were found to be satisfactory at the conclusion of the experiments in September, 1887. Can you produce an illustration substantially representing any other quick-action triple valve that was found to be satisfactory at that period?

A. The triple valve represented in "Exhibit Blue Print, First Form of Quick-action Triple Valve," when modified in some of its proportions, and when embodied in a brake apparatus, having its accessory parts properly proportioned and constructed, produces results equal to the best that were had from any of our quick-action triple-valve constructions.

189 Q. To what extent, if at all, other than as to dimensions or proportions, does the modification referred to in your last preceding

answer involve a departure from the structure and designed manner of operation of the quick-action triple valve represented in "Exhibit Blue Print, First Form of Quick-action Triple Valve"?

A. The modifications involve no change in structure, design, or mode of operation, and were confined entirely to the size of ports leading directly from the train-pipe to the brake-cylinder.

190 Q. By the term "accessory parts" employed by you in your answer to Q. 188, are we to understand that you mean any devices or parts other than or additional to those ordinarily employed in automatic air-brake apparatus, and employed at the date of 233 the Burlington 1887 trials, and, if so, to what other or additional devices or parts do you refer?

A. In speaking of "accessory parts," I did not refer to any additional devices or mechanism ordinarily employed in automatic air-brake apparatus or in use at the Burlington 1887 trials. I referred to such portions of the equipment as the train-pipe, the hose and couplings, the cocks, the branch pipes, the passages leading from the triple valve to the brake cylinder, and all of the elements ordinarily employed in air-brake apparatus that control or limit the free flow of air from the train pipe directly to the brake-cylinder.

191 Q. From your knowledge of and experience in the art of automatic air-brake construction, please state whether or not you believe a triple valve as represented in "Exhibit Blue Print, First Form of Quick-action Triple Valve," having its ports leading directly from the train-pipe to the brake-cylinder of proper proportions or dimensions, and embodied in a brake apparatus having the "accessory parts" to which you have referred properly proportioned and constructed, to be "impracticable," or not suitably or desirably adaptable to practical railroad service?

A. I believe the valve mechanism constructed in accordance with the blue print mentioned furnishes a practical and entirely satisfactory quick-action triple valve.

Recross-examination by CHARLES B. MANN, Esq.:

192 X Q. Admitting that the determination of questions relating to letters patent are not part of your duty as general manager of the Westinghouse Company, I ask is it not a fact that you have felt an especial interest in the several patents belonging to that company, and covering the three types of quick-action triple valves, and that you have frequently examined them and are more or less familiar with them?

A. It is a fact.

193 X Q. Is not the blue-print drawing, referred to in re- 234 direct question and answer 188, a working drawing, and does it not bear date January 5th, 1887, which was previous to the May, 1887, trials?

A. I presume it is a working drawing, and it does bear that date.

194 X Q. Were not the quick-action triple valves, which were tested in the May, 1887, trials, made, proportioned and constructed in accordance with this blue-print drawing?

A. I presume they were, but on this point I cannot speak definitely.

195 X Q. Is it not the fact that the train on which these severe shocks were produced in May, 1887, had valves that were made in accordance with the "blue print, first form of quick-action triple valve"?

A. I believe the valves on the train mentioned were substantially in accordance with the blue print.

196 X Q. Have any valves like that shown in the "blue print first form of quick-action triple valves" been made and sold by your company since December, 1887?

A. I believe not.

II. HERMAN WESTINGHOUSE.

Counsel for complainants offers and puts in evidence a certified copy of license from George Westinghouse, Jr., to the Westinghouse Air Brake Company, dated November 22d, 1880, and recorded in Liber Q 26, page 36, and the same is marked "Complainants' Exhibit License No. 1."

Also a certified copy of license from George Westinghouse, Jr., to the Westinghouse Air Brake Company, dated November 7th, 1890, and recorded in Liber L 43, page 49, and the same is marked "Complainants' Exhibit License No. 2."

Adjourned *sine die*.

235 United States Circuit Court, District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WEST-
INGHOUSE AIR BRAKE COMPANY

vs.

BOYDEN POWER BRAKE COMPANY; CHARLES
A. Boyden, President; Charles B. Mann,
Secretary, and William Whitridge, Treas-
urer.

In Equity. No. 321.

Depositions of witnesses and other evidence in reply on behalf of complainants in the above-entitled cause, taken under the 67th rule in equity, pursuant to notice, before F. E. Gaither, notary public, as agreed special examiner, at the office of Messrs. Kerr & Curtis, No. 120 Broadway, New York, commencing on Friday, November 24, 1893, at 10.30 a. m.

Present: J. Snowden Bell, Esq., of counsel for complainants, and
Lysander Hill, Esq., of counsel for defendants.

HENRY F. NEWBURY being recalled, deposes and says, in answer to interrogatories propounded to him by J. Snowden Bell, Esq., of counsel for complainants, as follows, to wit:

197 Q. Are you the same Henry F. Newbury who has heretofore testified in this cause?

A. I am.

198 Q. Have you read the depositions of defendants' witnesses George A. Boyden and Joseph B. Church, in this cause?

A. I have.

236 199 Q. Defendants' witnesses Boyden and Church appear to be of the opinion that a material difference exists between complainants' and defendants' devices, when operating as quick-action triple valves, by reason of the fact that, in defendants' quick-action triple valves, compressed air, both from the auxiliary reservoir and from the train-pipe, passes through the port controlled by the valve 22.

Please state at what point, in the Westinghouse quick-action valve of patent 360,070 in suit, these two air pressures unite, and state, with your reasons, whether the difference in the uniting points of such pressures, between such structure and those of the defendants, is a material or substantial difference.

Objected to, as implying a total misunderstanding of the substance of the testimony of defendants' witnesses on the point referred to—their testimony, in substance, being that the fact that valve 22 admitted both the auxiliary-reservoir air and the train-pipe air to the brake-cylinder, evidenced a totally different construction and mode of operation of the apparatus from that shown in complainants' patent No. 360,070; and they not having testified that the mere fact that the air from the two sources referred to united at one point or another point, considered by itself, made any substantial difference in the result.

A. The two pressures, viz. auxiliary-reservoir and train or brake pipe pressure, unite, in the mechanism illustrated in patent 360,070, in the chamber 47 shown in Fig. 5 of that patent, where they commingle and enter the passageway designated 48 in such figure, and thence pass into the brake-cylinder.

In my opinion, it is wholly immaterial and not of the slightest consequence whatever, at which point the two pressures, viz., auxiliary reservoir and train or brake pipe pressure, unite to
237 enter the brake-cylinder, so long as they unite under conditions which permit them to readily enter such cylinder, by reason of such point being in open communication therewith.

The essential thing, so far as the uniting of the two pressures is concerned, is, as I understand the matter, that they shall unite at some point where the conditions are such that they can readily enter the brake-cylinder, owing to the fact that such point is in open communication with such cylinder, and, so long as this is the case, it is wholly immaterial, and not of the slightest consequence whatever, whether such pressures unite in the chamber 47, as is the case in the mechanism illustrated in the patent in suit, or that they unite in the chamber C of said defendants' valves.

It is true that, in said defendants' valves, there are valves 22 which can close communication, under certain circumstances, between such chambers C and their respective brake-cylinders, but, notwithstanding this fact, said chambers C are as much in open communication with their respective brake-cylinders, at the only

time that train or brake pipe and auxiliary reservoir pressure unite to enter such brake-cylinders, upon making an emergency quick-action application of the brakes, as is the case with the chamber 47 of the mechanism illustrated in the drawings of the patent in suit, and, so long as this is the case, the difference in the points at which brake or train pipe and auxiliary reservoir pressures unite to enter their respective brake-cylinders, in the case of the said defendants' valves and the mechanism illustrated in the drawings of the patent in suit, is, in my opinion, an immaterial and a substantial difference.

It will be remembered that in my former deposition I placed upon plate IX of defendants' 1889 catalogue, the same letters, characters, and series of arrows which I used or placed upon plate X of defendants' 1891 catalogue. Because of this fact, I have used the same designating letters, in the present answer, that are found

upon the said two exhibits, and have therefore considered both of the valves together in the present answer, the slight difference in construction between the two valves being wholly immaterial, so far as the present answer is concerned.

The two defendants' valves referred to are the valves which have heretofore, in my former deposition, termed "defendants' 1889 quick-action brake-valve" and "defendants' 1891 quick-action triple valve."

For convenience, I will hereafter, throughout my deposition, when the difference in specific construction of the parts is not material in my opinion, to the answers to be made, treat the two exhibits as one, and term them "defendants' quick-action triple valves."

200 Q. To what extent, if at all, is the existence of the partition 9 material, in defendants' quick-action triple valves of defendants' 1889 and 1891 catalogues?

A. I believe that the part, in the mechanism shown in plate IX of defendants' 1889 catalogue, which corresponds to the partition 9 of plate XI of defendants' 1891 catalogue, was not marked by me at the time that I made the other markings heretofore referred to, and therefore I will, at this time, mark said partition, in plate IX of defendants' 1889 catalogue, with the numeral 9, so that it may correspond in marking with the corresponding partition in plate XI of defendants' 1891 catalogue.

The partition 9, of said defendants' quick-action triple valves is material and essential in said quick-action triple valves, as well as in every other quick-action triple valve with which I am acquainted including, of course, the one shown in the patent in suit.

The said partition 9 is the means by which a restricted or small port or passage is made between the auxiliary reservoir and the brake-cylinder, so that auxiliary reservoir air or pressure is restricted or retarded in its movement or passage from the auxiliary reservoir to the brake-cylinder, when a quick-action or emergency application of the brakes is to be made, so that the restricting or retarding action of such restricted port or passage, permits the lower brake or train pipe pressure to readily pass into the brake-cylinder, notwithstanding the fact that the higher auxiliary

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reservoir pressure is at the same time also entering the brake-cylinder.

This partition, and restricted passage or port, is necessarily located, relatively to the auxiliary reservoir and the triple-valve piston, so that such piston is open to auxiliary reservoir pressure, as in ordinary or plain triple valves, and can be acted upon by such auxiliary reservoir pressure on one side, and train or brake pipe pressure on the other, as in the case of such plain triple valves, as the same existed prior to the year 1887.

This restricted port or passage so restricts or retards the passage of auxiliary reservoir pressure, that notwithstanding the fact that such pressure is higher than that of the train-pipe, its volume is restricted, so that it, upon emerging from such port or passage, instantly expands and becomes lower in pressure than the train or brake pipe pressure, and it is owing to this sudden expansion of the auxiliary reservoir pressure, that the lower train or brake pipe pressure can enter the brake-cylinder in a comparatively large volume at the same time that the small volume of auxiliary reservoir air is also entering such cylinder. Of course, this only occurs when the two pressures unite to enter the brake-cylinder, upon a quick action or emergency application of the brakes, and the brake-cylinder is substantially free from pressure, and this only continues until the combined pressures in the brake-cylinder somewhat closely approximate the pressure in the brake or train pipe.

201 Q. What, if any, material or substantial difference is there, provided the air passes to the brake-cylinder, whether it all passes through one port (the port controlled by the valve 22), as in defendants' quick-action triple valves, or some of it passes through one port (22) and the remainder through another port (46) as in the structure of complainants' patent 360,070.

Objected to as immaterial and irrelevant, and not in rebuttal.

240 A. In my opinion it is wholly immaterial whether the fluid pressures pass through one port only, in order to reach the brake-cylinder, as in the case of said defendants' quick-action triple valves, or pass through two ports, as in the case of the quick-action triple valve illustrated in the patent in suit.

As I understand the matter, the essential thing, so far as the passage of the fluid pressure or compressed air from the auxiliary reservoir and the brake or train pipe to the brake-cylinder is concerned, is that the auxiliary reservoir pressure shall pass through a restricted port or passage as compared to the passageway through which the brake or train pipe pressure passes, and, so long as this is the case, it is wholly immaterial whether both pressures pass through only one port, as in said defendants' quick-action triple valve, or the auxiliary reservoir pressure passes through one port and the brake or train pipe pressure passes through another, as in the quick-action triple valve illustrated in the patent in suit.

This difference, the passage of both pressures through one port and their passage through two ports, is not a material or substantial

difference, so long as the essential conditions above named exist, as they do in the quick-action triple valves under consideration.

202 Q. Is the location of this restricted port or passage of any importance, and if so, to what extent?

Same objection.

A. It is not, so long as such restricted port or passage is located relatively to the brake-cylinder and the auxiliary reservoir so that the triple-valve piston is left in open communication with the auxiliary reservoir, to be acted upon by brake or train pipe and auxiliary reservoir pressures, as in plain triple valves as the same existed prior to the year 1887. This is the case with both the defendants' quick-action triple valves and the one shown in the patent in suit.

203 Q. As I understand the testimony of defendants' witnesses, they apparently seek to represent that Mr. Boyden was the originator, in an apparatus of the class in question in this suit, of a passageway, controlled by a check-valve, from the train-pipe side of a triple-valve piston to the brake-cylinder side.

Have you examined the state of the art sufficiently to say whether or not Mr. Boyden is entitled to the credit of such a construction, at the date of his patent No. 280,285, June 26, 1883, in which it is shown. If he is not entitled to it, where is it previously to be found?

A. I have examined the state of the art sufficiently to enable me to state that such a passageway controlled by a check-valve, as referred to in the question, was not new or original with Mr. Boyden in his 1883 patent mentioned. Such a passageway and check-valve was old in the art long before the year 1883.

Such a passageway and check-valve is found in British letters patent, No. 3,000 of 1879, and also in United States letters patent to Perkins, No. 163,242, dated May 11, 1875, and to Jones, No. 166,386, dated August 3, 1875.

Mr. Church, one of defendants' experts, in his answer to question 10, after referring to the prior art generally, says, at folio 816 (D. R.), as follows:

"It was also common to employ a check-valve for the feeding-in valve, similar to the check-valve 26 (or 11), said check-valve being carried by the piston, as in defendants' valve. This feature is shown in the Westinghouse patent No. 144,006; Perkins No. 163,243, Jones No. 166,386, and Boyden No. 280,285."

It will thus be seen that according to Mr. Church, one of defendants' experts, at least three different United States patents show such a passageway and check-valve, prior to Mr. Boyden's 1883 patent No. 280,285. It will also be seen that, according to Mr. Church,

212 the specific form of passageway and check-valve shown in one of the figures of Mr. Boyden's 1883 patent, and also in said defendants' quick-action triple valve, is found in the art prior to Mr. Boyden's 1883 patent—that is, a passageway from the train-pipe side of a triple-valve piston to the brake-cylinder side thereof, which passageway is directly through the triple-valve piston itself, and the

check-valve carried by such piston, and which controls such passageway, was found in at least three United States patents which preceded in date the Boyden 1883 patent referred to in the question.

Furthermore, an examination of the several patents specifically named by me, will show that both of the specific forms of construction of such passageway and check-valve shown in Mr. Boyden's 1883 patent, were old in the art at least several years before 1883.

From the above it will be seen that Mr. Boyden is not entitled to the credit of originating the specific form of passageway and check-valve found in defendants' quick-action triple valve, at the date of his 1883 patent, and some years prior thereto.

An examination of the said Jones patent No. 166,386 discloses the fact that the passageway directly through the piston, controlled by the check-valve carried by such piston, found in said defendants' quick-action triple valve, resembles in proportions the passageway and check-valve of said Jones patent more nearly than it does the passageway and check-valve shown in figure 5 of said Boyden 1883 patent No. 280,285.

The above answer is objected to by defendants' counsel as not in rebuttal.

Counsel for complainants offers in evidence a printed Patent Office copy of the Perkins patent referred to by the witness in the last preceding answer, and the same is marked "Complainants' Exhibit Perkins Patent."

243 Also a printed blue-book copy of British patent No. 3,000 of 1879, and the same is marked "Complainants' Exhibit British Patent 3,000 of 1879."

The introduction and use of said exhibits are objected to at this stage of the proceedings, as not being in the nature of rebutting evidence, nor pertinent in answer to anything testified to by defendants' witnesses.

Adjourned to Saturday, November 25, 1893, at 10.30 a. m.

NEW YORK, November 25, 1893—10.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of HENRY F. NEWBURY resumed:

204 Q. Mr. Boyden appears to be of the opinion, as stated at the bottom of page 21 (D. R.), that he was the first to provide, as in his 1883 patent No. 280,285, "a single valve H arranged to govern a port through which the air pressure from the main air pipe and the air pressure from the auxiliary reservoir both passed to the brake-cylinder," and he apparently presents this statement in such a way as to imply that he thereby invented something which was of importance in the development of the quick-action triple valve.

Please state whether or not there was anything, in this feature of the Boyden patent No. 280,285 of 1883, which tended to aid in the development of the quick-action invention.

Objected to as not correctly stating the meaning of Mr. Boyden, which was that the invention of said valve was of importance
 244 in developing the quick-action triple valve operating on the principle of the defendants' brake mechanism.

A. There is nothing, so far as I can find in the Boyden patent No. 280,285 of 1883, which, in any way whatever, aided, or tended to aid, in the development of the quick-action triple valve, in any of the forms that it exists today, so far as I am acquainted with such valves. The specification of the said Boyden patent, which for convenience I will hereafter refer to as the Boyden 1883 patent, confirms me in the above opinion. The object of the invention of the said Boyden 1883 patent is therein set forth in the following words:

"The objects of the invention are, first, to provide for replenishing, while the brake is on, the air reservoir of each car or the brake-cylinder when the pressure therein has been released by leakage, and to accomplish this through a single line of train-pipe and by means which shall at all times be wholly under the control of the engineer, and also to provide for the more rapid charging than heretofore of the air reservoir on the car, and also to obviate the necessity of applying the brakes with such a high pressure as heretofore was necessary with the automatic brake, the effect of which is to slide the wheels and flatten them; second, to provide for dispensing with the main air reservoir on or near the locomotive, and thereby simplify and cheapen the apparatus; third, to provide for the quicker release of the brake."

I think that it is manifest that, by no possible means, could an apparatus designed with the above-named object in view, aid, or tend to aid, in the development of the quick-action invention, because it will be seen at once that there is not a single thing contained in the above quotation which even hints at or suggests the quicker application of the brakes.

245 An examination of the apparatus shown and described in the said Boyden 1883 patent, discloses the fact that by no possible means can any train or brake pipe pressure pass through or by the triple-valve piston, so as to commingle with the auxiliary reservoir air in the valve chamber of such 1883 mechanism, when the valve II has opened the port or passage to the brake-cylinder, except after the brakes have been fully applied, or applied with their full maximum force, and, in addition to this, the air pressure has leaked out from the brake-cylinder and auxiliary reservoir to a considerable extent, so as to reduce the force with which the brakes are applied to the wheels of the car.

I am unable to see how anything in an apparatus of this character, could in any way aid, or tend to aid, in the development of the quick-action invention, which is the quickening of the action of each succeeding triple valve by the venting of the train-pipe at or near the first quick-action triple valve, so that, instead of the train or main air pipe pressure having to travel from the rear of the train to the locomotive, to escape to the atmosphere, it can escape

at each quick-action triple valve, and thus save the time in the bringing into operation of the succeeding triple valve.

A further examination of the said Boyden 1883 patent discloses the fact that no main air or train pipe pressure can pass through or by the triple-valve piston, after the brakes have been applied with their full maximum force, until the equalized pressure in the auxiliary reservoir and brake-cylinder has been reduced by leakage below the pressure existing in the supplemental air chamber, designated in such Boyden patent as L. Also, that the brakes cannot be held against the car wheels after they are first applied by the equalization of the pressures in the auxiliary reservoir and brake cylinder with the same or equal force, owing to the fact that the pressure in the supplemental chamber or reservoir L of that

patent expands, and, furthermore, there is necessarily a leakage in the piston which closes that chamber from the balance of the mechanism, the same as there would be from the auxiliary reservoir and brake-cylinder, therefore, the equalized pressures in the brake cylinder and auxiliary reservoir when the brakes are first applied, cannot be attained by the passage of train or main air pipe pressure through or past the triple-valve piston of that mechanism.

These facts disclose nothing which, in my opinion, would in any way tend to aid in the development of the quick-action invention, and, if anything, they would tend to lead one away from that invention.

The art prior to Mr. Boyden's 1883 patent, discloses a triple-valve mechanism containing a single valve, of the sliding type, which controls the port or passage to a brake-cylinder through which air from the main air or train pipe can pass directly into the auxiliary reservoir and brake-cylinder by passing into the valve chamber containing the valve which controls the port or passage leading into the brake-cylinder. Such a mechanism with such a single valve, is shown in the British patent No. 3000 of 1879.

Notwithstanding this fact, I do not understand that any one asserts that the presence, in the art, of said British patent, in any way tended to aid in the development of the quick-action invention.

Mr. Boyden, in his answer to Q. 8, folio 84 (D. R.) admits that the said 1883 Boyden patent was not for a quick-action valve, as that term is now understood.

All of the above-named facts confirm me in the opinion heretofore expressed in this answer, that there is nothing whatever in the said Boyden 1883 patent which in any way tended to aid in the development of the quick-action invention.

The foregoing answer is further objected to by defendants' counsel, as not in the nature of rebutting evidence.

205 Q. Defendants' witnesses have much to say about
247 "differential pressures" and "momentary differential pressures," and they seem to be of the opinion that Mr. Boyden was the first to originate or construct a quick-action triple valve

operating in that way. Please state whether or not this element of operation of a quick-action triple valve was new with Mr. Boyden, and if not, where previously it is to be found?

A. The element of "differential pressures" and "momentary differential pressures" is not new and original with Mr. Boyden, as I understand the use of those terms by defendants' witnesses.

"Differential pressures" and "momentary differential pressures," as I understand the use of such terms by defendants' experts, are pressures which differ in degree, in different parts of a quick-action triple valve, at different periods or moments of time, when a quick-action or emergency application of the brake is made. Such momentary differences in pressure in different parts of the quick-action triple-valve mechanism, permit the lower brake or main air pipe pressure to enter the brake-cylinder, notwithstanding the fact that the higher auxiliary reservoir pressure is also at the same time allowed to enter such brake-cylinder.

These momentary differential pressures are caused by retarding or restricting the flow of the auxiliary reservoir pressure into the passageway where it unites with the brake or main air pipe pressure. Such restricting or retarding action upon the flow of auxiliary reservoir pressure, permits the pressure, as it escapes from the restricted port or opening in the partition between the brake-cylinder and the auxiliary reservoir, to instantly expand as it passes through such port or opening into substantially free and open communication with the brake-cylinder, which, at this time, is substantially free from pressure. Such expansion of the auxiliary reservoir pressure reduces it much below the pressure in the main air or train pipe, so that the pressure from this pipe can enter the brake-cylinder in large volume, up to the time that the pressure which has entered the brake-cylinder approximates the pressure in
248 the brake or train pipe. This approximation in pressure between the brake-cylinder and the main air or train pipe, of course, prevents further passage of pressure from the latter to the former.

Of course all plain triple valves, or what are sometimes termed triple valves proper, depend upon momentary differential pressures for their operation, that is, the difference in pressure at different moments of time upon the opposite sides of the triple-valve piston, but I do not understand that defendants' experts refer to these differential pressures when they use the term as they have done.

"Differential pressures" and "momentary differential pressures," as these terms have been used by defendants' experts, refer, as I have heretofore explained, to the momentary differences in the pressures in different parts of a quick-action brake mechanism, when a quick action or emergency application of the brakes is to be made, and such "differential pressures" and "momentary differential pressures" exist in every quick-action brake mechanism with which I am acquainted, including, of course, the one shown in the patent in suit, and also those which preceded in date defendants' quick-action triple valves illustrated in plate IX defendants' 1889 catalogue and plate XI of defendants' 1891 catalogue.

Such "differential pressures" and "momentary differential pressures" are first found in the mechanism shown in the patent in suit, and, therefore, they were new and original with Mr. Westinghouse, and not with Mr. Boyden, as said defendants' witnesses seem to assert.

The partition with the restricted port or opening, located between the auxiliary reservoir and the brake-cylinder, and by means of which the "differential pressures" or "momentary differential pressures" are caused in the quick-action triple valve shown in the patent in suit, consists of the walls of the triple-valve piston bushing, designated as 24 in figure 2 of the patent in suit, and the balance of the casting or metal between such piston chamber 249 and the brake-cylinder, with a portion of the slide-valve 14, which slide-valve contains the restricted port or opening designated 35. The specification of the patent in suit described this restricted port or opening 35, and the size of the same, as follows:

"The feed-opening for the admission of air from the auxiliary reservoir to the brake-cylinder is purposely made of comparatively small diameter, it having been determined by experiment that the initial application of the brake should not be made with maximum force, and this opening may be made of such size and to apply the brake exactly in accord with the requirements of the most efficient work."

"The initial application of the brakes" referred to in the above quotation, I understand to be the first or initial portion of the application of the brakes, when making a quick action or emergency application, or, in other words, it refers to that portion of a quick action or emergency application, wherein brake or main air pipe pressure is admitted to the brake-cylinder, of course including whatever auxiliary reservoir air or pressure which may enter the brake-cylinder during the time that the main air or train pipe pressure enters it.

The specification of the patent in suit describes the passage leading from the main air or train pipe to the brake-cylinder, and into which auxiliary reservoir pressure expands, as it passes through the restricted port or opening 35 to enter the brake-cylinder, as

"A passage of considerable size open from the brake-pipe on each car, whereby the pressure is more quickly reduced, but the air so discharged is utilized in the performance of preliminary work, it being found in practice that the air so taken from the pipe will exert a pressure of about twenty-five pounds in the brake-cylinders."

This construction of the passageway leading directly from 250 the main air or train pipe to the brake-cylinder, of considerable size, and the making of the port 35 of comparatively small diameter, necessarily produces momentary differential pressures, whenever a quick action or emergency application of the brakes is to be made.

Because of these facts Mr. Boyden was not the first to originate or construct a quick-action triple valve operating so that "differential pressures" and "momentary differential pressures" take

place, and, so far as I know, the first time that a quick-action triple valve operating in this way appears in the art, is in the patent in suit, and Mr. Westinghouse was the first to originate and construct such a quick-action triple valve.

The foregoing answer is objected to by defendants' counsel as not in rebuttal.

206 Q. Please state what you understand to be the distinguishing characteristics of a "triple valve," as known in the art of railroad air brakes prior to 1887, with special reference to the several functions of such appliance or device.

A. The distinguishing characteristics or functions of a triple valve, as I understand the matter, are three in number, as the same existed prior to 1887.

First, controlling the admission of compressed air or fluid pressure from the main air or brake pipe to the auxiliary reservoir.

Second, controlling the admission of auxiliary reservoir pressure to the brake-cylinder, to apply the brake and,

Third, controlling the exhaust, or releasing a brake-cylinder pressure to the atmosphere, to release the brake.

The above are the distinguishing characteristics of triple valves, as the same existed prior to the year 1887, as I understand the matter.

251 The patent in suit describes triple valves, as they existed prior to the invention of the quick-action system, as follows:

"In using the terms 'triple valve' and 'triple-valve device' I refer to a valve device, however specifically constructed, having a connection with the main air or brake pipe, another with an auxiliary reservoir or chamber for the storage of power, and another with a brake-cylinder or its equivalent for the utilization of the stored power and with a release or discharge passage for releasing the operative power from the brake-cylinder, whether the valves governing these passages or connections are arranged in one or more cases and are moved by a piston or its equivalent, or by a series of pistons or their equivalents, there being numerous examples in the art of construction varying materially in appearance whereby these functions are performed, both in plenum and vacuum brake mechanism."

Two of defendants' exhibits herein, viz., the Boyden patents Nos. 481,134 and 481,135, define "triple valves." The definition in both of these patents, I believe, is in the same language, there being a variation of one word, which does not in any way alter the sense. I will quote from Defendants' Exhibit Boyden Patent No. 481,134, quoting the entire paragraph in which the definition of triple valves is found, commencing at line 111 and ending at line 127 of page 4 of that patent:

"As hereinbefore intimated, this valve mechanism belongs to the class of air-brake valves known as 'triple valves' of which there are numerous examples, differing somewhat in construction and embodying variations and modifications in the form and arrange-

ment of parts; but all of them, however specifically constructed, contemplate a valve structure having suitable connections for the train-pipe, the auxiliary reservoir, and the brake-cylinder, and are provided with passages or ports leading, first, from the train-pipe to the auxiliary reservoir; second, from the reservoir to the brake-cylinder, and, third, from the brake-cylinder to the atmosphere; hence the name triple valve. In some cases a plurality of valves govern these passages or ports."

Mr. Church, one of defendants' experts, in his answer to Q. 5, after referring to the old-style straight air or non-automatic system of brakes, then refers to the automatic system, which is a system by the use of which the brakes are self-applied, upon the breaking in two of the train or an accident occurring to the main air or train pipe by which it is ruptured, and the air, which is constantly maintained in such pipe, is allowed to escape. After briefly describing the automatic system, and the valve mechanism by which the compressed air or fluid pressure is controlled to do this work, he says:

"The mechanism through which this result or effect is produced and made possible is known as a 'triple valve' for the reason that it is arranged to control or effect three distinct lines of communication, one between the train-pipe and reservoir, through which the reservoir is charged with air under pressure; a second between the brake-cylinder and the atmosphere, through which the air is exhausted or allowed to escape when the brakes are released; and a third between the auxiliary reservoir and the brake-cylinder, through which the air is conducted for actuating the brakes."

From the above, it will appear that Mr. Church, one of defendants' experts, Defendants' Exhibit Boyden Patents, the patent in suit, and myself, all agree as to what are the distinguishing characteristics of a triple valve as known in the art of railroad air brake prior to 1887, and the several functions of such valve as then known.

207 Q. So far as the means of admitting pressure from the auxiliary reservoir to the brake-cylinder are concerned, in triple valves as known prior to 1887, what was the only essential consideration structurally in that regard?

A. The only essential consideration, structurally, so far as concerns the admission of auxiliary reservoir pressure to the brake-cylinder, in triple valves as they existed prior to 1887, was that the valve should be constructed to uncover the port or passage leading from the auxiliary reservoir to the brake-cylinder sufficiently to allow of such pressure expanding into the brake-cylinder to apply the brakes.

208 Q. How many valve-controlled ports, passages or channels, for the traverse of air under pressure from the auxiliary reservoir to the brake-cylinder, were required in a valvular appliance known prior to 1887, in order to enable it to be fully and truly a "triple valve"?

A. One only was all that was necessary.

209 Q. To what extent, if at all, would the addition of one or

more passages for reservoir air to the brake-cylinder, to the one which you say is all that is necessary, bear upon the question of whether or not the valvular appliance was what was termed a "triple valve" prior to 1887?

A. The addition of one or more passages or ports for the admission of auxiliary reservoir air to the brake-cylinder to the one referred to by me, would not, in any way, necessarily change such valvular appliance, and the same would still be termed a triple valve, as it was known prior to 1887.

210 Q. Defendants' witnesses seem to be of the opinion, or to desire to have the inference drawn from what they say, that if the valve 22, of defendants' quick-action triple valves, was fastened to its seat, said structures would not be triple valves at all, as
254 the term "triple valve" was used prior to 1887. What are the facts in this regard?

Objected to as embodying an erroneous assumption.

A. Defendants' triple valves, with the valve 22 fastened to its seat, so that it forms, in effect, simply a partition through which the triple-valve piston stem moved and formed a passage or port for the admission of auxiliary reservoir air to the brake-cylinder, would still be triple valves proper, or, as more generally termed, plain triple valves, notwithstanding the fact that the valve 22 was so fastened to its seat.

Defendants' quick-action triple valves, when the valve 22 was fastened to its seat, as stated in the question, would be triple valves, as that term was used prior to 1887, because they would then be capable of performing every function called for in triple valves at that date, and would also be capable of performing the functions of triple valves as defined by Mr. Church, in the said two Boyden patents, the patent in suit, and myself, and they would be as capable of performing all those functions, when the valve 22 was fastened to its seat, as they would be in the condition before the fastening of the valve to its seat occurred.

Furthermore, said defendants' quick-action triple valves, with the valve 22 fastened to its seat, would be, in the language of defendants' expert, Mr. Church, "arranged to control or effect three distinct lines of communication, one between the train-pipe and reservoir, through which the reservoir is charged with air under pressure; a second between the brake-cylinder and the atmosphere through which the air is exhausted or allowed to escape when the brakes are released; and a third between the auxiliary reservoir and the brake-cylinder, through which the air is conducted for actuating the brakes."

255 This would be as true with said defendants' quick-action valve, when the valve 22 was fastened to its seat, as it would be when such was not the case.

These three distinct lines of communication, as defined by Mr. Church, and when the valve 22 was fastened to its seat in defendants' quick-action valve, will be found graphically pointed out in Defendants' Exhibit Illustrative Cuts.

The first distinct line of communication, that is, the one between the train pipe and auxiliary reservoir through which the auxiliary reservoir is charged with air under pressure, will be found indicated by a red line in drawing No. 2 of such illustrative cuts.

The second distinct line of communication, that is, the one between the brake-cylinder and the atmosphere, through which the air is exhausted or allowed to escape when the brakes are released, will be found indicated by a yellow line in the same drawing of such illustrative cut.

The third distinct line of communication, that is, the one between the auxiliary reservoir and the brake-cylinder, through which the air is conducted for actuating the brakes, will be found indicated by a red line in drawing No. 4 of such illustrative cut.

By actual test, with a mechanism the same as said defendants' quick-action triple valves shown in plate XI of defendants' 1891 catalogue, except that a permanent partition was substituted in the place of the valve 22, so that by no possibility could there be any admission of fluid pressure through such partition, except as it passed through the port or passage in the stem of the triple-valve piston, as shown in said drawing No. 4 of defendants' illustrative cuts, I found that the mechanism of this character performed all of the functions of a triple valve proper as the same were known prior to 1887. These tests I repeated many times and always with the same results.

Some of the tests were made with this mechanism alone, and others were made where this mechanism was coupled up with some of the new Westinghouse quick-action triple valves, and I found with the mechanism, like said defendants' quick-action triple valve, with the permanent partition substituted for the valve 22, that as a matter of fact, so far as applying the brakes was concerned, except for a quick action or emergency application, there was no substantial difference between the operation of this mechanism as a triple valve proper and such new Westinghouse quick-action triple valves.

Furthermore, I have made repeated tests with a quick-action triple valve the same as shown in plate XI of defendants' 1891 catalogue, with glass windows in, so that the operation of the valve 22 could readily be observed, and in such case, although the tests were repeated many times, and every effort made to unseat the valve 22, when such apparatus was used as a triple valve proper, in every case the valve 22 remained seated until every function of a triple valve proper was served, that is, until the compressed air or fluid pressure in the brake-cylinder and auxiliary reservoir had equalized, and applied the brake with the full approximate force of the auxiliary reservoir pressure.

Of course, after the pressures in the auxiliary reservoir and brake-cylinder had equalized, and applied the brakes to the full maximum power of the auxiliary reservoir pressure to apply them, the valve 22 could be unseated, but when this occurred there was no function whatever of a triple valve proper to be served as such functions had been fully served before the unseating of the valve 22 occurred.

In attempting to unseat the valve 22 in these tests, before the full functions of a plain triple valve, or triple valve proper, as the same was known prior to 1887, were served, the valve 22 was repeatedly unseated, but, in each case, before such functions of the triple valve proper were served, the pressure from the train or brake pipe entered the brake-cylinder, to a greater or less extent, as we approached the point where the full functions of such triple valve proper were served. This fact, that train or main air pressure entered the
 257 brake-cylinder, was demonstrated by the action of a pressure gauge connected with the main air or train pipe side of the piston. In all of the foregoing tests, the auxiliary reservoir and brake-cylinder were also provided with pressure gauges, so that the pressures in such reservoirs and brake-cylinders could be read.

The above facts and tests compel me to the opinion that the valve 22 of defendants' quick-action triple valves is no part or portion of the triple valve proper, and is as useless in said defendants' quick-action triple valves, as a portion of the triple valves proper of those mechanisms, as a pocket would be for a toad to put his tail in.

211 Q. In defendants' illustrative cuts 2 and 4, which, as you have stated in your last preceding answer, show the three distinct lines of air communication as defined by Mr. Church, is the valve 22 shown as seated or unseated?

A. In each case this valve 22 is shown as seated.

212 Q. And how does the position of the parts, as shown in these two cuts, in effecting these three several lines of air communication, compare with the conditions which would obtain if the valve 22 was fastened to its seat?

A. They are identically the same as would be the case if the valve 22 was fastened to its seat, or a permanent partition was substituted for the same, as before described by me.

213 Q. I also understand defendants' witnesses to endeavor to show, argumentatively, that defendants' valve 22 is not an "auxiliary" valve, within the meaning of the claims of complainants' patent 360,070 in suit.

Please state your understanding of the essential requirements of an "auxiliary" valve, as that term is used in the art of quick-action air brakes, and as referred to in the claims of patent 360,070, and state also to what extent, and how, the defendants' quick-action triple valves comply with such requirements.

258 A. I understand that the essential requirements of an auxiliary valve, as that term is used in the art of quick-action air brakes, and as referred to in the claims of the patent in suit, to be as follows:

(1) That such valve is to be associated with another valve, which, in normal action, performs the functions of admitting and releasing auxiliary reservoir pressure to and from the brake-cylinders, and also with a valve admitting main air or train pipe pressure to the auxiliary reservoir.

(2) That such valve is arranged in a prescribed relationship to a passageway, port, or conduit, leading from the train or main air

pipe to the brake-cylinder, whereby it opens such passageway, port, or conduit, under abnormal conditions of use.

The said defendants' quick-action triple valves contain a valve known as valve 22, which complies with the above named requirements, as fully, and to the same extent, that the valve 41 of the mechanism shown in the patent in suit complies with such requirements.

That is, the valve 22 of said defendants' quick-action triple valves is associated with another valve (in my former deposition designated as main valve 17-18) which, in normal action or operation, performs the functions of admitting and releasing auxiliary reservoir pressure to and from the brake-cylinder, and also with the valve admitting main air or train pipe pressure to the auxiliary reservoir.

Again, the said valve 22 is arranged in a prescribed relationship to a passageway, port, or conduit leading from the main air or train pipe to the brake-cylinder, whereby it opens such passageway, port or conduit under abnormal conditions of use.

This passageway, port, or conduit, in said defendants' quick-action triple valve, is illustrated in drawing No. 8 of said defendants' illustrative cuts, and is there indicated by a blue line extending from the main air or train pipe to the brake-cylinder.

Adjourned to Monday, November 27, 1893, at 10.30 a. m.

259 NEW YORK, *November 27, 1893*—10.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of HENRY F. NEWBURY resumed :

(Answer to Q. 213 continued :) It is true that the valve 22 of said defendants' quick-action triple valves can be opened when a quick-action or emergency application of the brakes is not made, but notwithstanding this fact, the valve 22 is not necessary to any of the functions of a triple valve proper, and is associated with another valve mechanism which does perform all the functions of a triple valve proper, or, as more generally termed, a plain triple valve, as such functions have heretofore been set forth. Also the valve 22 is arranged in a certain way, or in a prescribed relationship to, a passageway, port, or conduit, leading directly from the train or main air pipe to the brake-cylinder, whereby it opens such passageway, port, or conduit, under abnormal conditions of use, such as in making a quick-action or emergency application of the brakes.

In all these respects, the valve 22 is as much an auxiliary valve as is the valve 41 of the mechanism shown in the patent in suit.

If the statement contained in defendants' 1891 catalogue is true, and Mr. Boyden, in his answer to X Q. 204, admits that it is, then the results accomplished by the said defendants' valve, as well as the actions while accomplishing such results, are the same as in the new Westinghouse quick-action triple valve, with which said defendants' valves are made interchangeable.

This statement in defendants' 1891 catalogue is as follows:

"The actions of this valve (defendants' quick-action triple valve in graduating, full service application, quick action and release, are the same as the new Westinghouse quick-action valve, thereby producing the same results in braking, which renders cars equipped with the two valves perfectly interchangeable the hose couplings being the same."

So long as the above statement is true, it is manifest, I think, that the valve 22, of said defendants' quick-action triple valves, must perform all the work of the auxiliary valve shown in the mechanism illustrated in the patent in suit, and also perform such work in the same way. Therefore, the valve 22 is necessarily an auxiliary valve, and a part of the quick-action portion of said defendants' quick action triple valves, and not a part of the triple valves proper of those quick-action triple valves.

214 Q. As I understand the views expressed by defendants' witnesses Boyden and Church, and more particularly summed up on page 28 (D. R.) by Mr. Boyden, they seek to make it appear that the port 35, near the outer or extreme end of the valve 14 of patent 360,070, is the "main" valve of that mechanism, and therefore is a part of the "triple valve proper," as distinguished from a quick-action attachment.

If there is any error or fallacy in such presentation of the facts, please point it out.

A. In my opinion, defendants' witnesses are in error in such presentation of the facts, and any statement which would necessarily make the port 35, of valve 14, a portion of the triple valve proper, of the mechanism shown in the patent in suit, instead of a part of the quick-action portion of that mechanism, is untrue, and against the statement of the patent in suit.

The specification of the patent in suit, at lines 4 to 19, on page 3 thereof, reads as follows:

"The construction and relative arrangement of the piston stem 13, slide-valve 14 and graduating valve 29, are substantially similar to those of the corresponding parts as heretofore employed by me and exemplified in my letters patent No. 220,556; but under
261 my present invention these are supplemented by a port 35, leading from the end of the valve adjacent to the opening of the chamber 24, which communicates with the auxiliary reservoir, to the face of the valve, so as, at the limit of traverse of the piston stem, in the application of the brake, to establish communication directly through said passage between the auxiliary reservoir and the port 23 and passages 22 and 16, leading to the brake-cylinder."

This statement of the specification of the patent in suit shows that the port 35 is supplemental to those portions of the mechanism which go to make up the triple valve proper of the quick-action triple valve shown in the patent in suit, and therefore, that it must be a part of the quick-action portion of that mechanism, which is contrary to the views of said defendants' witnesses, as particularly summed up on page 28 (D. R.) by Mr. Boyden, wherein he makes

the port 35 the main valve of the mechanism shown in the patent in suit.

The statement just heretofore quoted from the specification of the patent in suit, immediately follows a description of that portion of the mechanism which performs the ordinary functions in braking and which is designated in the patent in suit as "the triple valve proper 10" of that mechanism.

The specification of the patent in suit uses the following language, found at lines 29 to 51, page 2, thereof:

"So far as the performance of its preliminary function in ordinary braking is concerned—that is to say, effecting the closure of communication between the main air pipe and the auxiliary reservoir, and the opening of communication between the auxiliary reservoir and the brake-cylinder in applying the brakes, and the reverse operation in releasing the brakes—the triple valve 10 accords substantially with that set forth in letters patent of the United

States No. 220,556, granted and issued to me October 14, 262 1879, and is not, therefore, saving as to the structural features

by which it performs the further function of effecting the direct admission of air from the main air pipe to the brake-cylinder, as presently to be described, claimed as of my present invention. Certain of its elements devised and employed by me prior thereto will, however, be herein specified, in order to render its construction and operative relation to other members of the brake mechanism fully intelligible."

Then follows the description of the triple valve proper of this mechanism, after which follows the quotation first made in this answer. After the said first quotation follows a description of the means by which "the direct admission of air from the main air pipe to the brake-cylinder" is accomplished.

These statements compel me to the opinion that the port 35 is supplemental to the main valve of the triple valve proper of the mechanism shown in the patent in suit, and therefore, is no part or parcel of such triple valve proper, but is, in fact, wholly for, and a part of, the quick-action portion of that mechanism, and that said defendants' witnesses are wholly in error, in attempting to make it appear that such port 35 is a portion of the triple valve proper of the mechanism shown in the patent in suit.

The statements found in the above quotation would seem to make it manifest that the prior Westinghouse patent No. 220,556 is not sufficient warrant for attempting to make it appear that the port 35 is the main valve of the mechanism shown in the patent in suit, and, as I understand the testimony of said defendants' witnesses, this prior Westinghouse patent is the only warrant they find for asserting, or attempting to make it appear, that the port 35 is the main valve of the mechanism shown in the patent in suit.

The only place in the patent in suit where I find the term 233 "main valve" is in the first and last claims thereof, and such term is nowhere found in the descriptive portion of the specification of such patent.

In this last or 7th claim of the patent in suit, the term "main

valve" is therein defined or described by its functions, and, furthermore, the port 35 is therein made supplemental to such main valve, as will fully appear by the reading of such claim, which is as follows:

"7. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, an auxiliary valve actuated by the piston stem and controlling communication between passages leading to connections with a main air pipe and with a brake-cylinder, respectively, and a main valve connected to the piston stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere, respectively, said main valve having a supplemental port or passage which establishes communication between the auxiliary reservoir and brake-cylinder connection at or near the limit of the traverse of the main valve in effecting the application of the brake under maximum pressure, substantially as set forth."

The valve herein referred to as being connected to the piston stem and governing ports and passages in the case leading to connections with the auxiliary reservoir and a brake-cylinder and to the atmosphere, respectively, and called therein "a main valve," is the valve described in the descriptive part of the specification and therein referred to as the valve 14, which is connected to the piston stem 13, the latter of which is described therein as "carrying, as in my letters patent 220,556, before mentioned, a slide-valve, 14, which controls communication between the auxiliary reservoir and the brake-cylinder, and between the brake-cylinder and release port 15, respectively." These words will be found at lines 64 to 70, of page 2, of the patent in suit.

These statements leave no doubt in my mind as to what the construction of the main valve of said claim 7 is, and also, that the port 35 therein referred to as "a supplemental port or passage which establishes communication between the auxiliary reservoir and brake-cylinder connections at or near the limit of traverse of the main valve in effecting the application of the brake under maximum pressure," is supplemental to such main valve, and is no part of the triple valve proper, but belongs wholly to the quick-action portion of the mechanism shown in the patent in suit.

The above statements, taken in connection with the descriptive portion of the specification, leave no doubt in my mind but that the main valve, referred to in claim 1 of the patent in suit, is also the main valve referred to in claim 7 thereof.

It will be observed that in claims 4, 5 and 6 of the patent in suit there is a valve defined or described, by functions, in the following language:

"A valve moving with the piston stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere respectively";

Which valve, so far as functions go, is identical with the valve termed in said claim 7 "a main valve," and, therefore, is substantially the same valve as that of claim 7.

It will also be observed that, in claims 4, 5 and 6, there is another valve termed the "auxiliary valve," which, as stated in claims 4 and 5, is "actuated by the piston stem and controlling communication between passages leading to connections with a main air pipe and with the brake-cylinder, respectively," and in claim 6 as an auxiliary valve connected to the auxiliary stem and controlling communication between passages leading to connections with a main air pipe and with the brake-cylinder, respectively," which auxiliary valve is manifestly auxiliary to the one before referred to, which, therefore, is the *main valve* of those claims.

These facts also compel me to the opinion that defendants' witnesses are wholly in error as to the port 35 being any part of the triple valve proper, and that such port is supplemental to the main valve, and, therefore, a part of the quick-action portion of the mechanism shown in the patent in suit.

215 Q. Wholly regardless of what opinion you may have, or what conclusion you may draw from patent No. 360,070, as to the *character* of, or nomenclature properly applicable to, the port 35 of said patent, will you please state, as a matter of fact, to what extent, if at all, it is physically possible for said port to perform any function whatever, in any operation of the mechanism of said patent as a triple valve proper," that is to say, in any operation whatever other than that of effecting the quick-action application of the brakes?

A. As a matter of fact, it is a physical impossibility for the port 35 to be opened, at any other time than when the auxiliary valve is, shown in the patent in suit, is also opened, and it is also a physical impossibility for said port 35 to perform any function whatever, in any operation of that mechanism when it is used as a triple valve proper, and it is only brought into use when a quick-action or emergency application of the brakes is to be made.

Mr. Boyden in answer to X Q. 161, (fols. 464-5 D. R.) admits that it is a physical impossibility to open the port 35 without opening the valve 41. His said answer is as follows:

"A. I will admit that I consider it a physical impossibility to open the port 35 without opening the valve 41."

216 Q. I call your attention also to the statement of Mr. Boyden on page 30 (D. R.) that "this distinctly shows that the complainants' device uses two valves to perform the quick application of the brakes, one of which belongs to the *triple valve proper*, while the other is an *auxiliary valve additional* to the triple-valve structure."

To what extent do you agree with this statement, and others of like tenor?

A. I do not agree with the statement contained in the question, or others of like import, which would imply that any portion whatever of the triple valve proper, or any valve which may be said to belong to the triple valve proper of the patent in suit, is used in making a quick application of the brakes, if by such statement it is intended to assert that the port 35 is any portion of the triple

valve proper, that is, is any portion of the mechanism of the patent in suit which is essential or necessary in such mechanism, while it is serving the function of a triple valve proper, as such valve has been defined by defendants' witnesses both in their testimony and in the specifications of patents in evidence herein.

The two valves to which Mr. Boyden refers on page 30, (D. R.) are composed of the port 35 and the auxiliary valve 41 shown in the patent in suit, and, as before stated, with my reasons at length, this port and valve belong wholly to the quick-action portion of that mechanism and not to the triple valve proper. My reasons, I think, will be apparent from what I have heretofore said without again repeating them.

217 Q. I call your attention to Mr. Boyden's classification of valves and valve functions of patent 360,070 in suit, on page 29 (D. R.) under the head of "fifth valve." Please state whether you find Mr. Boyden's classification to be a correct one, and point out any erroneous or misleading statements therein, if there be such?

A. Mr. Boyden on said page, at folio 115, states that:

"The number of valves shown and described in complainants' patent No. 360,070 to perform the 'triple-valve' and 'quick-action' functions are five, four of which belong to the triple valve proper, and the fifth or auxiliary valve is added to admit air from the main air pipe to the brake-cylinder."

I understand that these so-called five valves, four of which belong to the triple valve proper, as set forth by Mr. Boyden, refer to the classification which he had made in his deposition, just preceding the statement quoted by me, the four valves belonging to the triple valve proper being found on the preceding page of defendants' record, and the fifth one on the page referred to in the question.

In my opinion, Mr. Boyden's said classification of valves is incorrect and misleading. As I understand the matter, there is no warrant whatever for any classification which would make four of the five so-called valves named by Mr. Boyden, as belonging to the triple valve proper, and, furthermore, in my opinion, any classification which gave more than four functions or valves to the mechanism shown in the patent in suit would be erroneous, for, as I understand the matter, there are but four functions, or valve functions, of such mechanisms, which are as follows:

(1) A valve to control the admission of train or main air pipe pressure to the auxiliary reservoir, to charge the latter with compressed air.

(2) A valve for controlling the admission of auxiliary reservoir pressure to the brake-cylinder, to apply the brakes.

(3) A valve for exhausting or releasing brake-cylinder pressure to the atmosphere, to release the brakes; and,

(4) A valve controlling the admission of main air or train pipe pressure directly from such pipe to the brake-cylinder, for applying the brakes with great rapidity and maximum force.

The above four valve functions, or so-called valves, are all that is necessary or essential in a triple-valve mechanism capable of per-

forming the three classes of work referred to by me in my former deposition as "graduation," "service stops," and "emergency stops," or as referred to by defendants' witnesses, Mr. Boyden and Mr. Church, as graduating, service stops, and quick-action applications of the brakes.

It is true that a classification which makes these so-called valves five in number can be made, but notwithstanding this fact, in my opinion, the said classification of Mr. Boyden is incorrect and misleading, because, while it is possible to make a classification in which there are five so called valves, yet only three of them can be said to belong to the triple valve proper of the mechanism shown in the patent in suit, which three would not include the port 35, which Mr. Boyden has termed the fourth valve of his classification, but such port 35 would belong wholly to the quick-action portion of the mechanism shown in the patent in suit.

I am confirmed in these opinions by the admission of Mr. Boyden, in his answer to X Q. 161 heretofore quoted, his statement in answer to R. D. Q. 237, which in substance is, that in a quick-action application of the brakes, if the port 35 was plugged up so that no air could pass through, it would practically destroy the efficiency of the brakes in making such quick-action application, and his answer to X Q. 152, wherein he admits that only four functions of the valve mechanism are recited in the description of the operation of the mechanism shown in the patent in suit, and that these four functions are as follows:

(1) To admit air from the main air pipe to the auxiliary reservoir.

(2) To admit air from the auxiliary reservoir to the brake-cylinder through the port controlled by the graduating valve 29, to apply the brakes in making ordinary stops.

(3) To exhaust air from the brake-cylinder to the atmosphere, to release the brakes, and;

(4) To effect the admission of air directly from the main air pipe to the brake cylinder, to apply the brakes with great rapidity and with their greatest available force.

218 Q. What, if anything, do you find in the construction and operation of the quick-action triple valve as described in patent 360,070, which would require or imply the port 35 to be used in ordinary braking, that is to say, if the quick-action operation was dispensed with, and the structure was used merely as a triple valve proper?

A. There is nothing whatever, so far as I can find, in the construction and operation of the mechanism shown in the patent in suit, No. 360,070, which would imply or require the port 35 to be used in ordinary braking, and when the quick-action operation, or emergency application of the brakes, was dispensed with.

If, for any reason, it was desired that the quick-action operation of the brakes be dispensed with, then a stop could be placed in the triple-valve piston chamber, designated in the patent in suit as 11, so that the valve 41 of that mechanism would never be moved sufficiently to open the port 42 of that mechanism, and, when this was

done, then the mechanism would perform every function of a triple valve proper, and perform each and all of such functions, in precisely the same way that it would perform them without such step in the piston chamber, and the port 35 could, by no possibility, perform any function whatever, or in any way affect or influence any of the functions served by the portions of the mechanism which go to make up the triple valve proper.

Of course, it will be understood that so long as the valve 41 cannot open the port 42, the port 35 is entirely useless, as it cannot register with any part of the port or passage 23 leading to the brake-cylinder, which it can do when the port 42 is opened by the valve 41. In this connection, I will refer to Mr. Boyden's admission, in answer to X Q. 161, wherein he says that the port 35 cannot be opened without also opening the valve 41. The opening of the port 35 is only accomplished by bringing it in register with the port or passage 23 before referred to.

219 Q. Referring to the statement of defendants' 1891 catalogue, to the effect that defendants' quick-action triple valves are
270 interchangeable with the Westinghouse quick-action triple valves, and keeping in mind the theory of defendants' witnesses that the valve 22 of defendants' structures is made to work as a main valve in service stops by a careful manipulation of the engineers' valve, what does the fact of the interchangeability of the structures indicate to you, as regards their substantial identity for quick-action purposes, when made up in the same train and all worked by the ordinary Westinghouse engineers' valve. In other words, in a train so made up, and in ordinary use, would the Westinghouse engineers' valve make suitable provision for such careful manipulation as would tend to cause the valve 22 to act as a main valve, or will it always and invariably be a quick-action valve?

Objected to, in so far as the question involves the Westinghouse engineer's valve, for the reason that such valve is no part of the matter here in controversy, is not essential to the operation of the device in question, and is not the only kind of engineer's valve that can be, or is, used with this class of apparatus; wherefore, its introduction into the question renders the interrogatory irrelevant and immaterial and the answer incompetent.

A. In my opinion, the Westinghouse engineers' valve would not make suitable provision for the careful manipulation of the valve 22 so that it might act as a main valve, according to the theory of defendants' witnesses, when in a train made up of cars equipped with defendants', and with new Westinghouse, quick-action triple valves.

The facts that defendants' valves are to be interchangeable with the new Westinghouse quick-action triple valves, and that the action of said defendants' and the new Westinghouse quick-action valves are the same, in graduating, full service application, quick
271 action, and release of the brakes, and that the results produced are the same, would indicate that both kinds of valves must respond to the same reductions of train or main air

pipe pressure, as well as to the same increase in pressure. If this was not the case, of course the actions of the two valves would be different, and, consequently, the results produced would also be different. For instance, with a reduction in train-pipe pressure caused by the manipulation of the engineers' valve which would cause the triple-valve pistons of the new Westinghouse quick-action triple valves to move into position for a graduating application, the pistons of the said defendants' quick-action triple valves must also necessarily move into such position, and, in the new Westinghouse valve, such graduating position is also the position for a service stop, or the application of the brakes with the greatest available power of the auxiliary reservoir alone, consequently such position of the triple-valve piston, in defendants' valves, when making a service stop, or a stop with the full available power of the auxiliary reservoir, is the graduating position of the triple-valve piston in said defendants' quick-action triple valves.

In other words, the only difference, in the new Westinghouse quick-action triple valve, between a graduating application and a full-service stop, is the difference between the time that the handle of the engineers' valve is held in the graduating position, that is, whether the handle is changed almost instantly after it had been placed in the graduating position, so that there is only allowed the time necessary for admitting a small quantity of auxiliary reservoir air to the brake-cylinder, for making a graduating application, or whether the handle of the engineers' valve is left in such graduating position for a continuous escape of train-pipe pressure, and consequently a continuous admission of auxiliary reservoir pressure to the brake-cylinder, until an equalization of pressures in the brake-cylinder occurs, when the brakes are applied with the full available pressure of the auxiliary reservoir. If said defendants' valves are to be interchangeable, they must necessarily so operate that the valve 22 remains seated and cannot by any possibility act as a "main valve" in a train made up of said defendants' and the new Westinghouse quick-action triple valves as before stated.

In fact, in such a case, the valve 22 will always and invariably act, if it acts at all, as a quick-action valve, or rather as an auxiliary valve in a quick-action triple valve.

In order that said defendants' quick-action triple valves shall have the interchangeability referred to in said defendants' 1891 catalogue, any reduction of pressure in the main air or train pipe which would open the valve 22 would necessarily be such as would, at the same time, open communication directly from the main air or train pipe to the brake-cylinders, in the new Westinghouse quick-action triple valves, and therefore communication would likewise be opened from the main air or train pipe directly to the brake-cylinders connected with said defendants' quick-action triple valves, and the valve 22 would then act not as a "main valve," but as a portion or part of the mechanism relating wholly to quick-action or emergency stops.

In this connection, I would state that I have made experiments

with a valve like that shown in plate XI of defendants' 1891 catalogue, when coupled up with one of the new Westinghouse quick-action triple valves, and always found that the action of the valve 22, of said defendants' quick-action valve, operated as a portion of the quick-action devices, and not as a "main valve," when so coupled up, that is, any reduction in train-pipe pressure which would operate the new Westinghouse quick-action triple valve, for graduating or full-service application of the brakes, would invariably leave the valve 22 seated, and likewise any reduction of pressure in the main air or train pipe which would unseat the valve 22, would also open communication directly between the main air or train pipe and the brake-cylinder connected with the new Westinghouse quick-action triple valve, which facts confirm me in the opinion heretofore expressed in this answer.

In these tests, as in others referred to by me, pressure gauges were used on the auxiliary reservoirs and brake-cylinders, and also upon the brake or train pipe side of the triple-valve piston, by which it could be determined what the pressures were in the respective parts of the apparatus.

I am also of the opinion that any engineers' valve with which I am acquainted, and which can be used with the new Westinghouse quick-action triple valves, in a train made up of both defendants' and the new Westinghouse quick-action triple valves, cannot be used so as to unseat the valve 22 of said defendants' valves, without also opening direct communication between the main air or train pipe and the brake-cylinders connected with the new Westinghouse quick-action triple valves.

In this connection, I have witnessed tests made with an engineers' valve having different-sized openings, which tests were made with a view to make the valve 22, of a quick-action triple valve like that shown in plate XI of defendants' 1891 catalogue, operate as a "main valve," that is, so as to open it and have pressure pass from the auxiliary reservoir to the brake-cylinder, without, at the same time, having main air or train pipe pressure also pass to the brake-cylinder, but this in each case was not done, although every effort possible was made to accomplish it. In each case, the pressures in the auxiliary reservoir and brake-cylinder equalized, before the opening of the valve 22, or, if this had not occurred, main air or train pipe pressure passed into the brake-cylinder notwithstanding the efforts made to have the valve 22 unseat before the equalization of pressures in the auxiliary reservoir and brake-cylinder had taken place.

The above facts compel me to the opinion that if there is to be any interchangeability whatever, of the character set forth in said defendants' 1891 catalogue, of the said defendants' and the new Westinghouse quick-action triple valves, that any engineers' valve which is capable of use with a new Westinghouse quick-action triple valve would invariably and always cause the valve 22, of said defendants' quick-action triple valves, to act as a portion of the quick-action devices of those valves, and that such engineers' valve cannot, by any careful manipulation, be made to

cause the valve 22 to operate as a main valve, upon the theory of defendants' witnesses.

These last-named tests were made with a single quick-action triple valve, like that shown in plate XI of defendants' 1881 catalogue, and having glass windows in it, so that the operation of the valve 22 could be observed, and pressure gauges were arranged in the auxiliary reservoir, brake-cylinder, and the brake or main air pipe side of the triple-valve piston, so that the momentary pressures could be observed in the different parts of the apparatus.

220 Q. Referring to the Boyden patent No. 481,134, a copy of which is in evidence, I find on page 5, lines 86 to 95, the following statement, to wit:

"It will be seen that my present invention for introducing train-pipe air into the brake-cylinder for emergency stops differs essentially from the device shown in the said patent No. 360,070, because I have provided a new principle of construction and a new mode of operation, by use of which the desired result aforesaid may be produced without the aid of the auxiliary valve heretofore required for the purpose."

State, with your reasons, whether or not you find the statement I have quoted to be a true and correct one?

Adjourned to Tuesday, November 28, 1893, at 10.30 a. m.

275 NEW YORK, November 28, 1893—10.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of HENRY F. NEWBURY resumed:

A. to Q. 220. In my opinion, the statement in the question, quoted from Boyden patent No. 481,134, is untrue and incorrect, and not in accordance with the facts.

I find, upon turning to the specification of the said Boyden patent, that it contains a description of the mode of operation of the mechanism set forth in that patent, which description shows that, instead of there being a *new mode of operation*, there is the same mode of operation as found in the mechanism of the patent in suit.

In fact, the description of the mode of operation of the quick-action triple valve of said Boyden patent, as therein contained, is as much a description of the mode of operation of the quick-action triple valve set forth in the patent in suit, as it is of the quick-action valve of the said Boyden patent, or, in other words, the description of the mode of operation of the said Boyden patent, as aptly applies to the mode of operation of the quick-action triple valve of the patent in suit, as it does to the quick-action valve of said Boyden patent.

Of course, the designating letters or characters used in one patent would have to be substituted for those used in the other patent, to designate corresponding parts therein, and there would have to be a slight change, in one or two places, owing to the fact that auxiliary reservoir pressure unites with the train or main air pipe pressure at a somewhat different point, in the quick-action triple

valve shown in the said Boyden patent, from the point at which the two pressures unite in the quick action triple valve shown in the patent in suit, but these changes in no way alter the sense of the description, as such description applies to one mechanism as well as it does to the other, when the above changes are made.

In order to illustrate this fact, I will quote such description from the said Boyden patent No. 481,134, from the point where the reduction in train-pipe pressure has been made, which has brought the parts of the mechanism into position for a quick-action or emergency application of the brakes to take place.

I will also, in addition to making such quotation, place within brackets all designating terms or changes in language, as above indicated, in order to make the description apply to one quick-action triple valve or to the other, and, immediately after the matter placed in brackets, I will place the characters or language to be substituted, as above indicated, in italics, so that when the quotation is to be read, the matter within the brackets is to be read, omitting the matter in italics, and, on the other hand, when the description is to be read as applying to the Westinghouse quick-action triple valve, the matter within brackets is to be omitted, and that in italics is to be read in the place thereof.

This description will be found in lines 18 to 88, page 4, of the said Boyden patent.

"The piston [G] 12 will in the meantime be held to its outward position by the relatively higher air pressure from the auxiliary reservoir, which is delivered through the large [passage R] *valve chamber 24*, while the transmission of auxiliary reservoir air to the brake-cylinder is retarded by having to pass through the relatively smaller [passage *i*] *port 35*. During its preliminary traverse outward, or toward the train-pipe side, the piston [G] 12 operates to close the exhaust passage, and its farther or continued movement in the same direction opens the [main valve F] *valve 41 and port 35*, and allows air to pass from both the auxiliary reservoir and the train-pipe to the brake-cylinder, when making a quick application of the brakes. It will be observed that the valve mechanism depends for its action upon the movement of the piston [G] 12, and that the latter is subjected to two opposing forces—auxiliary reservoir air on one side and train-pipe air on the other—and that its movement in one direction is effected by the preponderating pressure of auxiliary reservoir air, while its movement in the opposite direction results from a preponderance of pressure on the train-pipe side. If the [passage *i*] *port 35*, through which auxiliary reservoir air must flow [upon the sudden opening of the main valve port *e*] for an emergency stop, was as large as or larger than the check-valve passage for supplying train-pipe air, the quick action referred to and the utilization of train-pipe air direct in the brake-cylinder could not be effected, for the very obvious reason that the inward flow of train-pipe air at, say, fifty-five or sixty pounds, to the brake-cylinder, would be opposed and checked by the flow of auxiliary reservoir air at a higher pressure,

say seventy pounds; but by restricting the *the* passage through which auxiliary reservoir air is conducted in the course of its transmission to the brake-cylinder, so that its capacity for the flow of air will be less than that of the [main port *e* and less than the] check-valve passage leading from the train-pipe, a considerable volume of train-pipe air will flow into the brake-cylinder, notwithstanding the admission of the auxiliary reservoir air under a high pressure, because the flow of auxiliary reservoir air is so retarded by the smaller [passage *i*,] *port 35*, through which it is conducted, that an appreciable period of time is required to raise the pressure in the brake-cylinder to that in the auxiliary reservoir, and it is during this interval, and before the pressure in the brake-cylinder is raised to that in the train-pipe, that the air in the latter is free to enter the brake-cylinder. It will thus be seen that the sudden
 278 [uncovering of the main port or passage *e*, leading] *opening of the port 35 and passageway controlled by valve 41 which lead* to the brake-cylinder, by the movement of the [main valve] *piston 12* opens communication between the train-pipe and brake-cylinder, and also between the auxiliary reservoir and the brake-cylinder; but that the flow of the higher pressure air from the auxiliary reservoir into the brake-cylinder is retarded, by being compelled to traverse a relatively small orifice or passage, while the lower pressure train-pipe air is permitted to flow through a larger orifice or passage."

Reading the above quotation as it applies to the quick-action triple valve shown in the Boyden patent, and then by reading the same words, except omitting those within brackets, and including those in italics, as before suggested, will, I think, make it manifest that the description applies as aptly to one quick-action triple valve as it does to the other, and also, that the mode of operation is identically the same, and that there is no new principle of construction in said quick-action triple valve of said Boyden patent, but that the principle of construction is the same as that of the quick-action triple valve of that shown in the patent in suit, and that the difference between the two is only in specific details, which do not affect the mode of operation of the two valves.

A careful examination and comparison of the principle of construction and mode of operation of the quick-action triple valve shown in said Boyden patent, with that shown in the patent in suit, discloses the fact that the two quick-action triple valves are substantially identical in principle of construction and mode of operation, and also, that what slight differences in specific details of construction are found, are such as do not affect the principle of construction or the mode of operation of the two valves, and are
 279 wholly due to the fact that the higher auxiliary reservoir air unites with the lower train or main air pipe pressure or air, to pass or expand into the brake-cylinder, at a somewhat different point, in the quick-action triple valve of said Boyden patent, than is the case with the quick-action triple valve shown in the patent in suit.

I have heretofore explained at length that this difference in the

point at which the higher auxiliary reservoir air unites and communicates with the lower main air or train pipe air, to pass or expand into the brake-cylinder, in the two quick-action triple valves under consideration, is wholly immaterial, and I will not repeat such reasons at length, but simply say that such differences are immaterial because, in each case, they unite at a point which is practically in open communication with the brake-cylinder, and the two pressures can readily expand and enter the brake-cylinder, and this is as true in one case as in the other.

Such examination and comparison of the quick-action triple valve of the two patents, one with the other, also discloses the fact, that in each there is a valve auxiliary to the valve which controls communication between auxiliary reservoir and brake-cylinder, and the brake-cylinder and open air, for applying and releasing the brakes respectively, and therefore, that the said quick-action triple valve of the Boyden patent is provided with an auxiliary valve, the same as is the case with the quick-action triple valve of the patent in suit. Hence, the statement quoted in the question is incorrect and untrue in this respect, as well as in the other respects heretofore pointed out in this answer.

Because of these facts, I am compelled to the opinion that the said quoted statement of the question is untrue and incorrect.

So far as the above answer purports to quote from the Boyden patent a description of the mode of operation of the structure described in that patent, the quotation is objected to by defendants' counsel, for the following reasons, to wit:

(1) Because it is garbled and incomplete. The full description of the mode of operation commences at line 111, page 3, of the specification of the Boyden patent, with the words, "When it becomes necessary or desirable to apply the brakes of a train quickly and with full power for an emergency stop."

To omit the descriptive matter found between that point and the beginning of the quotation made in the witness' answer, is to omit the most vital part of the description. There are several other passages in the specification of the Boyden patent, descriptive of the mode of operation of the quick-action devices therein shown, which should also be included in the quotation to render it complete.

(2) Because, in making the quotation, the witness has substituted, in place of the matter contained in the Boyden patent, matter of description which does not relate to the devices of the Boyden mechanism, but to other and different devices, and has, without explanation, assumed such devices to be the same, or substantially the same, as those of the Boyden patent.

(3) Because the alleged quotation, garbled and altered by the introduction of other matter, evinces simply an effort to confuse and mislead the court as to the structures under consideration.

221 Q. Please examine the subject-matter contained in patent 481,134, from line 111, page 3, to line 18, of page 4, and state what, if anything, you find contained in such descriptive matter, or in any other portion of the specification of the patent, which in any-

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wise tends to modify the views expressed in your last preceding answer?

A. I have examined the subject-matter contained in patent 281 481,134 from line 111, page 3, to line 18 of page 4, as called for in the question, although I had heretofore carefully examined such subject-matter, and there is nothing contained in such subject-matter, which in any way affects or changes the meaning of the language quoted by me from said Boyden patent 481,134, wherein the operation of the mechanism was set forth.

If the language contained between lines 111, page 3, and line 18, page 4, would in any way affect the operation of an apparatus or quick-action valve of that patent, I should have quoted it in the first instance, for the simple reason that I have no desire whatever to mislead or confuse the court.

The matter contained between lines 111, page 3, and 18, page 4, relates to the reduction of pressure in the main air or brake pipe, necessary for a quick-action application of the brakes to be made, and also explaining that when the triple-valve piston is brought to its extreme rearward position, by such reduction, the valve chamber is opened to the brake-cylinder, so that the higher auxiliary reservoir pressure, and lower brake or train pipe pressure, when they unite, can readily expand into the brake-cylinder, because the point of uniting of these pressures is in open communication with the brake-cylinder, which is also the case at the point where the corresponding pressures unite to enter the brake-cylinder in the quick-action triple valve of the patent in suit. These are necessary conditions in any and every quick-action triple valve, and arise wholly, in the quick-action triple valve of the Boyden patent 481,134, from the fact stated in my previous answer, namely, that the higher auxiliary reservoir and lower main air or train pipe pressure unite in the quick-action triple valve of said Boyden patent at a somewhat different point from what the corresponding pressures unite to enter the brake-cylinder in the quick-action triple valve in the patent in suit.

The quotation of the matter between lines 111 of page 3 282 and 18 of page 4, would, if anything, tend to mislead or confuse the court, instead of bringing out into clear and distinct

light the fact that the actual principle of construction or mode of operation of the quick-action triple valve of said Boyden patent was substantially identical with that of the quick-action triple valve of the patent in suit. I cannot see how the quotation of such matter would in any way tend to make clearer the facts of the case, and, if I had seen how the quotation of the matter between lines 111 of page 3 and 18 of page 4 would make clearer such facts, I should have unquestionably quoted it, for it is my earnest desire to present the facts just as they exist.

There is no question but what certain differences in construction exist between the quick-action triple valve shown in said Boyden patent and the one shown in the patent in suit, and such differences arise principally from the fact stated in my previous answer, that the auxiliary reservoir and main air or brake pipe pressures unite

to expand into the brake-cylinder, at a somewhat different point from that at which the corresponding pressures unite in the quick-action triple valve shown in the patent in suit, but this fact, as before stated, does not change the principle of construction upon which the two mechanisms work, or their mode of operation, so that the mode of operation of the quick-action triple valve of the said Boyden patent can be said to be a new mode of operation.

In my former answer, I stated the fact that there was a difference in the point at which the auxiliary reservoir and main air or train pipe pressure united to expand into the brake-cylinder in the quick-action triple valve of the said Boyden patent, and the point at which the corresponding pressures united in the quick-action triple valve of the patent in suit, so that it would be distinctly understood that this difference existed and was recognized in the answer and thus express the facts.

I do not find anything in any other portion of the said Boyden patent 481,134 which, taken in connection with the portion
283 of the specification of that patent which I quoted in my former answer, would change the mode of operation set forth in that quotation, or in any way affect its meaning.

I am confirmed in the opinions expressed in this, and my preceding answer, namely, that the mode of operation or principle of construction of the quick-action triple valve shown in Boyden patent 481,134 is not a new mode of operation, or a new principle of construction, by the statement made by Mr. Boyden, in answer to X Q. 187, which, in substance, is, that there is no difference in the mode of operation between defendants' two valves shown in defendants' catalogues of 1889 and 1891, and in answer to X Q. 191, where he admits that it is a fact that the quick-action triple valve shown in plate IX defendants' 1889 catalogue, is patented in and by letters patent 481,134, and the statement contained in said defendants' 1891 catalogue, that the quick-action triple valve shown in plate XI of the last-named catalogue, is interchangeable with the new Westinghouse quick-action triple valve, as heretofore set forth.

If there is no difference in the mode of operation between the defendants' two valves shown in catalogues 1889 and 1891, and the valve shown in the 1889 catalogue is patented in and by Boyden patent 481,134, and the valve shown in defendants' 1891 catalogue is interchangeable with the new Westinghouse quick-action triple valve, it necessarily follows that there is no difference in the mode of operation between the quick-action triple valve shown in Boyden patent 481,134 and the new Westinghouse quick-action triple valve, and this is substantially admitted by Mr. Boyden, one of defendants' experts, and the person upon whose application the Boyden patent was granted.

Objected to by defendants' counsel, on the ground that the witness, in this answer, has given an incomplete and incorrect statement of the substance of the descriptive matter contained in the
284 Boyden patent between lines 111, page 3, and 18, page 4—dwelling at length upon matters that are immaterial, and totally ignoring the essential and vital parts of the description.

Counsel for complainants suggests that the foregoing objection is not well founded, for that it merely recites the opinion of defendants' counsel, which may or may not be a correct one.

222 Q. To what extent, if at all, is your answer to Q. 220 applicable to the following statements of the Boyden patent No. 481,135, to wit:

"It will be seen that the means I have thus provided for introducing train-pipe air into the brake-cylinder for 'emergency stops' differs, essentially, from that shown in said patent No. 360,070, and that said means involves a new mode of operation" (lines 73 to 79 page 1).

"An examination of the particular embodiment of the present invention will disclose the fact that it is a triple valve *per se* without auxiliary or supplemental valve devices, and, further, that its conversion into a 'quick-action' valve and its greater capacity for action over previous forms of triple valves is due to means here employed for transmitting train-pipe air direct to the brake-cylinder through the triple-valve chamber C and through the port *c* of the triple main valve, and at the same time retarding or restricting the flow of auxiliary reservoir air to the said main ports as compared with the more open or free delivery of train-pipe air to said main port. It will also be seen that a single valve 22, the main valve of the triple valve proper, here performs the office of opening a port *c* to the brake-cylinder, through which port both the train-pipes and the auxiliary reservoir airs pass in the quick application of the brakes for emergency stops" (lines 80 to 181, p. 4).

285 A. My answer to Q. 220 is applicable to the statements quoted from Boyden patent 481,135, to the same extent as to the statement found quoted from patent 481,134 in question 220, so far as a new mode of operation of the mechanism shown in patent 481,135 is concerned, and also, to the statement regarding auxiliary or supplemental valve devices of the quotation in the present question.

Immediately following the last quotation in the present question, namely, at line 102, page 4, of Boyden patent 481,135, it is stated:

"In my application for letters patent filed September 30, 1889, serial No. 325,474, I have shown and described a valve for automatic air brakes of the same type as that which constitutes the subject-matter of the present specification. In my said earlier application the fundamental features of the invention have been claimed. The present specification therefore relates to certain improvements in the construction of said valves."

Turning to the beginning of the specification of patent 481,134, it will be seen that it was granted upon an application filed September 30, 1889, serial No. 325,474, the same as stated in the above quotation.

From this it appears that the quick-action triple valve shown in the two patents are of the same type, and therefore must have the same mode of operation and principle of construction.

Mr. Boyden, one of defendants' experts, in answer to X Q. 190,

struction simply renders the mechanism incapable of use, for any practical purpose in connection with an automatic air-brake system.

There are other reasons why the device set forth in patent 289 317,838 would render an automatic air-brake system useless, but it would seem that the above is a sufficient reason for the opinion expressed regarding this device and its practical use in an automatic air-brake system.

224 Q. Where, if at all, in patent 360,070, can you find any warrant for the interpolation, by defendants' witness J. B. Church, into his recital of the functions of the auxiliary-valve device of said patent, of the words "without passing through the triple valve proper" (D. R., fol. 743, page 186)?

A. I am unable to find any warrant whatever in the patent 360,070 for the limitation contained in the words quoted in the question upon the auxiliary-valve device of claim 1 of such patent. There is certainly nothing in the claim which calls for such limitation upon the auxiliary-valve device of that claim.

There is nothing that I can find in the drawings or the descriptive part of the specification which would seem to require any such limitation as Mr. Church has seen fit to adopt, and which is referred to in the question.

The quick-action triple valve shown in the drawings of the patent in suit No. 360,070 provides for the direct admission of brake or train pipe air into the brake-cylinder, by passing through a portion of the triple valve proper, as such triple valve proper is described in the patent in suit, that is, the main air or train pipe pressure which enters directly into the brake-cylinder without passing into the auxiliary reservoir, passes through a passageway, port, or conduit, through which auxiliary reservoir air or pressure always passes when the mechanism of the patent in suit is used as a triple valve proper, and therefore, such direct admission of main air or train pipe pressure is through a portion of the triple valve proper, or, generally stated, is through the triple valve proper, and not, as stated by Mr. Church, without passing through the triple valve proper. The portion of the triple valve proper through which the

290 direct admission of air or fluid pressure is made from the brake or train pipe, is as much a portion of the triple valve proper as any other portion of that mechanism which is used in making a graduating or full service application of the brakes, or, as stated by me in my former deposition herein, when performing the first two classes of work, namely, "graduation" and "service stops."

225 Q. Where, if at all, in patent 360,070, can you find any warrant for the limitation imposed by Mr. Church on the triple valve of said patent, that it shall "control the admission of auxiliary reservoir air to the brake-cylinder, both for graduating and full pressure applications of the brakes." (D. R., fol. 746, page 187.)

A. I am wholly unable to find any warrant whatever in patent 360,070, for the condition which Mr. Church has seen fit to impose upon the triple valve of the first claim of the patent in suit, if he meant, by the language quoted, that there was any difference be-

tween what he has styled "graduating and full pressure applications of the brakes," except that there is a difference in the time for the admission of auxiliary reservoir pressure to the brake-cylinder as heretofore explained by me.

226 Q. In the analysis of claim 1 of patent 360,070 made by Mr. Church on pages 185 and 186 (D. R.) he recites, among what he terms the "parts or elements" of said claim, the following, to wit:

"2. Means for maintaining and varying the air pressure in said main air or train pipe."

To what extent, if at all, do you consider the statement of such a part or element to be correct or justifiable in the analysis of said claim?

A. The "means for maintaining and varying the air pressure in said main air or train pipe," which Mr. Church has made his second part or element, in his analysis of said claim 1, I understand includes the engineers' valve, the main reservoir, and the air pump, with the engine which operates it, situated upon the locomotive.

As I understand said claim 1, it does not include such engine, air pump, main reservoir, engineers' valve and the necessary connections contained upon the locomotive, as any part or parcel of the combination particularly pointed out in claim 1 of the patent in suit.

As I understand said combination, it is complete when it contains the several parts or devices therein mentioned, when combined together in substantially the manner set forth in the descriptive part of the specification, and adapted for use in an automatic quick-action system of brakes, or, in other words, that the "brake mechanism" referred to in said claim 1, only refers to those portions of the mechanism necessary to make up the equipment of a single car.

Because of such understanding, I do not consider Mr. Church's statement of such a part or element of the combination recited in claim 1 to be correct or justifiable, in an analysis of the devices or elements of said claim.

227 Q. How far, if at all, do you consider Mr. Church's recital of what he terms the "fifth" element of claim 2 of patent 360,070 (D. R., pp. 187, 188) to be correct or well founded?

A. I do not consider Mr. Church's recital of what he terms the fifth element of the second claim of the patent in suit to be correct or well founded.

It would seem to me that Mr. Church must have had in mind the third claim of the patent in suit, instead of the second, when he made the recital of the said fifth element or part referred to in the question.

I do not find any warrant whatever, in claim 2 of the patent in suit for the limitation Mr. Church has seen fit to impose upon his said fifth part or element in his analysis of that claim, which limitation is in the following words:

"And effecting a second admission of auxiliary reservoir air to the brake-cylinder by the further movement or completion of the full stroke of the valve piston."

292 I am unable to find anything in said claim 2 which would afford any warrant whatever for this limitation to be placed upon the triple valve referred to in said claim, and which Mr. Church has referred to in his said analysis as the fifth element.

It is true that such a second admission of auxiliary reservoir pressure to the brake-cylinder, as referred to by Mr. Church, is one of the limitations placed upon the combination recited in claim 3 of the patent in suit by the terms of such claim, but said claim 2 does not contain any such limitation.

There are other reasons why I do not think Mr. Church's recital of what he terms the fifth element of said combination of claim 2 of patent in suit, is correct and well founded.

If he had stated his said fifth element somewhat as follows, then I would have had to agree with him as to what such element is in said combinations:

5. A triple valve properly provided with two passages, one passage leading from the auxiliary reservoir to the brake-cylinder and the other passage leading direct from the main air or train pipe to the brake-cylinder, and also provided with a valve mechanism actuated by the piston of the triple valve which controls the two passages, the piston of the triple valve being adapted to have two traverses or movements, the first or preliminary one of which actuates the valve mechanism and opens the passage between the auxiliary reservoir and the brake-cylinder, and the second or further traverse or movement opens the direct passage between the main air or train pipe and the brake-cylinder.

The above statement of the fifth element of the combination recited in claim 2 of the patent in suit seems to me enumerates every condition that is called for by the terms of said claim 2, and is all that is required of the triple valve mentioned in said claim.

I understand that Mr. Church, when giving his fifth element of said claim 2, includes, as one of the preceding elements of his analysis, the second element of said claim 1, and, as before explained in a previous answer, I do not understand that such element or part is any part of said claim 1, and consequently, would not be of said claim 2. Therefore, instead of making the triple valve proper, as before explained, the fifth element, I would make it the fourth, omitting Mr. Church's second.

Mr. Church, in giving his said analysis of the second claim of the patent in suit, says:

"I understand this claim to include the first four enumerated elements of the first claim, and, in addition thereto, a fifth element, as follows:"

228 Q. Do you or not find the following statement of Mr. Church (D. R. fol. 819, page 205) to be a true and correct one, to wit:

"the main valve H of the patent [No. 220,556] controlling the direct passage between valve chamber and brake-cylinder, and only operated to uncover the port leading to the brake-cylinder when the piston is actuated by the preponderance of auxiliary reservoir air pressure, and caused to make its full stroke, finds its functional

equivalent in the main valve 22 (or 15) of defendants' triple valves."

Adjourned to Wednesday, November 29, 1893, at 10.30 a. m.

NEW YORK, *November 29, 1893.*

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of HENRY F. NEWBURY resumed:

A. to Q. 228. In my opinion, the statement referred to in the question is not a true and correct one. The language quoted in the question is found in the paragraph which commences as follows:

294 "Referring to said patent No. 220,556 of 1879 and comparing the same with defendants' triple valves, I find that they all possess substantially the same functions, are made up of equivalent parts that operate in substantially the same manner, omitting, of course, the quick-action function of defendants' valve and the means by which such action is produced."

From this it will be seen that the main valve II of patent 220,556, and the main valve 22 (or 15) of defendants' valves, are compared by Mr. Church in said paragraph, and are the valves which, in his opinion, are equivalent in function.

I wholly disagree with Mr. Church in any such opinion as this, and as a matter of fact, the main valve II, of patent 220,556, does not find its functional equivalent in the so-called main valve 22 (or 15), of defendants' triple valve.

Turning to said patent 220,556, it will be seen that the valve II of that patent has certain functions to perform, which are, controlling communication between the auxiliary reservoir and the brake-cylinder, to apply the brakes, and also, controlling communication between the brake-cylinder and the atmosphere, to release the brakes, or, in other words, the valve II has to be moved so as to close communication between the brake-cylinder and the atmosphere, as well as to open communication between the auxiliary reservoir and the brake-cylinder, in order that any kind of an application of the brakes can be made, and also, that the valve II has to be moved to close communication between the auxiliary reservoir and the brake-cylinder, and open communication with the brake-cylinder and the atmosphere, in order that any kind of a release of the brakes can be made, and that in either case this is true whether it be a partial or full application, or a partial or full release of the brakes.

Comparing the valve 22 (or 15), of defendants' quick-action
295 triple valve, with the valve II of patent 220,556, it will be seen that even Mr. Church or Mr. Boyden, defendants' experts, do not even intimate that the valve 22 (or 15), of defendants' quick-action triple valve, has anything whatever to do, or that any movement whatever of such valve can take place upon a partial application or partial release of the brakes, with said defendants' quick-

action triple valve, or, in other words, they do not assert, or even intimate, that the valve 22 (or 15) of said defendants' quick-action triple valve, has any function or movement in the application or release of the brakes, in a graduating application of the same.

As I understand the testimony of both Mr. Church and Mr. Boyden, they attempt to assert that the valve 22 (or 15), of said defendants' quick-action triple valve, only opens or performs any valve function when the triple-valve piston is moved to the full extent of its stroke, and brings the parts of the mechanism into position for a quick action or emergency application of the brake, and the conditions, or momentary differential pressures, are such that they interfere with the direct admission of main air or train pipe pressure to the brake-cylinder, and thus two to five pounds of pressure are admitted to the brake-cylinder from the auxiliary reservoir, before the pressures in the reservoir and cylinder have equalized, and consequently, the valve 22 (or 15), of said defendants' quick-action triple valve, permits auxiliary reservoir air, to this small extent, to pass through the port opened by such valve 22 (or 15).

From this it will be seen that the valve H, of patent 220,556, does not, even according to the showing of defendants' experts, find its functional equivalent in the valve 22 (or 15) of defendants' quick-action triple valve.

As before stated, and for the reasons heretofore given at length, which I do not think need repeating here, the said valve 22 (or 15), of said defendants' quick-action triple valve, has to do wholly with the quick-action portion of said defendants' valve, and not 296 with the part or portion of those valves which serve the function of a triple valve proper.

Furthermore, all of the functions of a triple valve proper can be performed by said defendants' quick-action triple valves, without the presence of the valve 22 (or 15), and none of the functions of a quick-action or emergency application of the brakes can be served by the said defendants' quick-action triple valve, except that the valve 22 (or 15) be present, as is clearly shown from the tests witnessed by me and heretofore described.

These facts compel me to the opinion that the statement of Mr. Church referred to in the question is incorrect and untrue, and that the valve H of patent 220,556 does not find its functional equivalent in the valve 22 (or 15) of said defendants' quick-action triple valves.

229 Q. Do you, or not, find the following statement of Mr. Church, in folios 827, 828, p. 207 (D. R.) to be a true and correct one, to wit:

"A comparison of the mechanism of defendants' triple valve with the triple valve of patent 141,685 of August 12, 1873, will serve to illustrate the fact that the main valve 22 of the 1891 triple valve (which operates to perform the same functions of admitting auxiliary reservoir air to the brake-cylinder upon the full stroke of the piston, and is the equivalent of main valve 15 in the 1889 triple

valve) is the main valve, and corresponds in its functions with the main valve *a*, of the patent referred to?"

A. I do not find the said statement of Mr. Church's to be true and correct, because a comparison of the mechanism of defendants' quick-action triple valve with the triple valve of patent 141,685 of August 12, 1873, shows that the valve *a* of such patent is necessarily moved in both directions in making a partial application of the

brakes, as well as when a partial release of the brakes is to be made, and this is not the case with said defendants' quick-action triple valve, even according to Mr. Church's own description. This fact illustrates the incorrectness of Mr. Church's said statement, and shows the fact to be that the valve 22 of the 1891 triple valve, and the valve 15 of the 1889 triple valve, is not the main valve of those mechanisms, and that they do not correspond in function with the valve *a* of patent 141,685.

The valve *a*, of patent No. 141,685, which Mr. Church has termed "main valve *a*" of that patent, is not so termed in the patent itself, but is there called a "charging valve *a*," and as there shown and described, simply controls communication between the auxiliary reservoir and brake-cylinder, and is not, in my opinion, correctly termed by Mr. Church, and it will be just as correct to term the valve *h*¹ a main valve, which latter valve controls the release or exhaust of fluid pressure from the brake-cylinder, by controlling communication with such cylinder and the atmosphere. This latter valve, the said patent terms a "discharging valve *h*¹."

In order to have a valve correctly termed the "main valve" of a triple valve proper, or, as more generally termed, a plain triple valve, it must, in my opinion, be capable of performing the main function in a triple valve proper, or plain triple valve, such, for instance, as controlling the lines of communication between the auxiliary reservoir and the brake cylinder, and between such cylinder and the atmosphere, or at least must serve some function, and be moved in order to serve such function, in connection with both of these lines of communication, when the mechanism serves the functions of a triple valve proper. This is the case with the main valve H of patent 220,556, and is not the case with the charging valve *a* of patent No. 141,685, and, in order to get anything which corresponds in function to a main valve, as I understand the same, in this latter patent, it would require to have both the charging valve *a* and discharging valve *h*¹, to make up such valve, and one would no more be the *main valve* of that mechanism than the other.

Because of these facts, I am compelled to the opinion that the statement of Mr. Church's referred to in the present question, is incorrect, untrue, and misleading.

230 Q. In his discussion of the operation of defendants' quick-action triple valve, plate IX defendants' 1889 catalogue, Mr. Church says, on page 196 (D. R.)

"The conversion of this triple valve proper, possessing the ordinary triple-valve functions, into a *quick-action* triple valve is most

ingeniously effected by the proper proportioning of the air ports or passages."

And he goes on to say, in that connection, how "it becomes possible to produce on occasion *differential pressures* in the piston chamber and the valve chamber," &c.

It is my impression that you have given, in your previous testimony, a statement of your view to an entirely different effect from that as above expressed by Mr. Church, and I wish you would state briefly whether I am correct in this, and, if it is necessary to make yourself clear, refer to any previous portions of your deposition by reference to which a reply to this question may be stated as briefly as possible?

A. My views do not coincide with those expressed by Mr. Church in the statements referred to in the question, as will appear, I think, in those portions of my deposition regarding the materiality of the partition 9, the point where the auxiliary reservoir and main air or train pipe pressures unite to enter or expand into the brake-cylinder, and what I have said regarding "*differential pressures*" and "*momentary differential pressures*," and where an apparatus was first found in which there was a quick-action triple valve which necessarily worked upon the principle of such momentary differential pressures.

231 Q. Do you, or not, find the statement of Mr. Church, in folios 850, 851, page 213 (D. R.), that "the results effected by the additional members of the patented device (patent 360,070) are produced in defendants' valves directly by the triple valve proper and without the addition of an extra passage or an auxiliary valve" to be a true and correct statement?

A. In my opinion, the statement of Mr. Church, referred to in the question, is not a true and correct presentation of the fact.

I have heretofore, at considerable length, given my reasons why there is an auxiliary valve in the said defendants' triple valve, and that the said auxiliary valve is necessarily an addition to said defendants' valves, when such valves are used simply as triple valves proper, or, in other words, the said defendants' valves are provided with an additional valve, which is auxiliary to the valves which perform the ordinary function of a triple valve proper, and without which it would be impossible for said quick-action triple valves to make a quick-action or emergency application of the brakes.

It is true that in said defendants' valves the passage, port, or conduit, through which the direct admission of main air or train pipe pressure to the brake-cylinder takes place, is also utilized for the passage of main air or train pipe pressure to the auxiliary reservoir, but such passage, conduit, or port, is given an *extra capacity* over what is required as a feeding-in port or passage for admitting main air or train pipe pressure to the auxiliary reservoir.

Furthermore, if defendants' quick-action triple valves were not provided with a passage, conduit, or port, having this extra capacity, they would be incapable of making a quick-action or emergency application of the brakes, and therefore, this extra capacity of the passage, conduit, or port, of said defendants' quick-action triple

valve, is additional to any of the functions of a triple valve proper, and is also useless for anything else than a quick-action or emergency application of the brakes, and belongs wholly to the quick-action or emergency part or portion of said defendants' quick-action triple valve, and is as much additional to what is necessary for a triple valve proper, in the case of said defendants' valves, as that part of the passage, conduit, or port, of the patent in suit, which is used alone for the direct admission of main air or train pipe pressure to the brake-cylinder.

In this connection, I would say that I have witnessed various tests with quick-action triple valves like the one illustrated in plate XI of defendants' 1891 catalogue, wherein the check-valve, which is designated in said plate XI as 26, was so limited in its movement that it could only open sufficiently to form a feeding-in port or valve, for controlling the admission of main air or train pipe pressure to the auxiliary reservoir, and, in every case, it was simply an impossibility for a quick-action or emergency application of the brakes to be made, and this was also the case, even when such check-valve 26 could open more than was necessary or desirable to form a feeding-in port or passage for admitting main air or brake pipe pressure to the auxiliary reservoir.

These tests leave no doubt in my mind, and also, I think, make it apparent, that the said defendants' quick-action triple valves have an extra passage, port, or conduit, in function as much so as in the case in the quick-action triple valve shown in the patent in suit.

These tests also show that the statements of Mr. Church immediately following the one quoted in the question, are, to say the least, misleading. These statements are as follows:

"And that the only substantial change which is required to convert a triple valve proper into what is known as a 'quick-action triple valve' is the separation of the valve chamber from the auxiliary reservoir end of the piston chamber, and the introduction of the small passage *c* (or B) through which auxiliary reservoir air is compelled to pass in entering the valve chamber. *With these changes* and the use of a check-valve for the feeding-in valve (a use which was common in the art as exhibited in numerous prior patents, as, for example, patents Nos. 144,006, of October 28, 1873; 166,386 of August 3, 1875, and 280,285 of June 26, 1883,) *Mr. Boyden has succeeded in making a triple valve perform the operation of admitting train pipe air directly into the brake-cylinder without interfering with its functions as a triple valve proper, and without the addition of anything corresponding in name, construction or mode of operation with the auxiliary valve and its passage connecting the train-pipe and brake-cylinder, which auxiliary valve and passage constitute two of the three additional members of the patent 360,070, and are absolutely essential to the operation of the device described in the patent, when used to effect a discharge of train-pipe air directly into the brake-cylinder.*"

With the changes suggested by Mr. Church, namely, the separation of the valve chamber from the auxiliary reservoir end of the piston chamber, by the introduction of the small passage *c* (or B),

and the addition of a check-valve for a feeding-in valve, the same as shown in patent 280,285, there would not be produced a structure which would necessarily *asily* perform the operation of admitting main air or train pipe pressure directly into the brake-cylinder, and there would have been left something else to be done in order that such a result could be accomplished.

This something else would be the giving of the check-valve passage, port, or conduit, a capacity which it is not shown to have in said patent 280,285, and this has been done in said defendants' quick-action valve.

Because of the above facts, I am compelled to the opinion that said defendants' quick-action triple valves have an auxiliary valve and an extra passage, conduit, or port, in function at least, and that said valves are only able to accomplish the result that they do accomplish, by reason of additional members being added to a
302 triple valve proper, and that such additional members are, in substance, the same as those found in the patented device of the patent in suit, and that they perform the same functions in substantially the same way; and, it is admitted by Mr. Boyden, one of defendants' experts, that according to defendants' 1891 catalogue, the actions of said defendants' valves, and the results produced by such actions, are the same, and so long as this is true, and I believe it is unquestioned, the said defendants' valves must necessarily be provided with additional members, which are, so far as actions and results go, substantially the same as those of the patent in suit.

232 Q. In his answer to Q. 12, Mr. Church alleges that there is a difference in "principle or mode of operation" between the patented device of patent 260,070 and the defendants' device. Do you or not, find the supposed difference alleged by Mr. Church in his answer to exist?

A. As a matter of fact, there is no difference in principle or mode of operation between the said defendants' device, which I understand to be defendants' quick-action triple valve, and the quick-action triple valve shown in the patent in suit No. 360,070, and I have heretofore in my deposition given the reasons for so stating, and will not, at this time, repeat them. I have also described tests which show that the fact is as above stated.

The reasons above referred to will be found in those portions of my deposition which refer to the principle of construction and mode of operation of said defendants' quick-action triple valve and the quick-action triple valve shown in the patent in suit.

233 Q. In his answers to questions 14 and 15, Mr. Church comments upon and criticises your testimony as to the quick-action triple valve of patent 360,070, the defendants' quick-action triple valves, and the classes of work performed. Please indicate the error or fallacy, if any, that you may find in Mr. Church's statement of his views?

303 A. Mr. Church at the beginning of his answer to Q. 14, states that I have sought to convey the impression that the quick-action triple valve of patent 360,070 is adapted to perform three classes of work, namely, "graduating," "service stop," and

"emergency stop," and that the ordinary triple valve, whether of the form shown in patent 220,556 or other known form, is capable of performing but two of the three enumerated classes of work, to wit, "graduating" and "service stops," and then says, in his opinion, I am in error and the facts do not justify my conclusions.

In my former deposition I defined the three classes of work, which I so termed (folios 102 to 106, C. R.). Mr. Church utterly fails to point out anywhere in the prior art, including patent 220,556, where any mechanism is found by which the three classes of work as defined by me can be performed, and does not even assert, as I understand his testimony, that there existed in the art prior to the date of the invention of the patent in suit, a mechanism by which such three classes of work could be performed.

Mr. Church totally ignores my definition, and simply attempts to show that, so far as a single triple valve proper is concerned, that the Westinghouse patent 220,556 shows a mechanism by means of which the brakes controlled by such a single valve can be applied quicker than when a graduating application of the brakes, as he terms my first class of work, is made, and that this would necessarily be done by the engineer when he desired to apply his brakes in the case of an accident, or when the train broke in two, or the train-pipe burst and allowed of the entire escape of the main air or train-pipe pressure therefrom.

It would seem that these comments of Mr. Church upon the three classes of work as termed by me, and upon patent 220,556 in connection therewith, were simply a play upon words, for he does not even make the attempt to show that patent 220,556 can perform the third class of work as defined by me in my previous deposition; therefore, I think the simple fact that he does so fail, is a sufficient answer to what he has said in connection with this matter, and makes it perfectly plain that there was no error whatever upon my part, and that the facts do justify my conclusion, but are fatal to his opinion.

I will here state that the first class of work which I, in my former deposition, termed "graduating" is what I understand defendants' experts, including Mr. Church, refer to as "a graduating application of the brakes."

The second class of work, which I termed as "service stop," said defendants' experts term "a service-stop application of the brakes."

The third class of work, which I termed as "emergency stops," said defendants' experts have termed as "a quick-action application of the brakes or, "a quick-action or emergency application of the brakes."

In each case, the class of work which I designated as third and termed "emergency stops" and the same class of work which defendants' experts have termed "a quick-action application of the brakes," or "a quick-action or emergency application of the brakes" is the same, and each requires that there shall be a direct admission of main air or brake pipe pressure to the brake cylinder, in addition to the pressure entering the brake-cylinder from the auxiliary reservoir, and it seems to me wholly

immaterial, and not of the slightest consequence whatever, whether these three classes of work are termed as I term them in my former deposition, or are termed as defendants' experts have so termed them in their depositions, which latter terminology I have largely used in the present deposition.

The essential thing is, so far as concerns the third class of work, that a direct admission of main air or train pipe pressure to the brake-cylinder takes place as set forth by me in my former deposition.

At folio 102, (C. R.) I give the reason why triple valves have become known as quick-action triple valves, and then state that such quick-action triple valves, in automatic systems of brakes, perform three classes of work, enumerating such classes as above stated, and also defining the occasions when such three classes of work would be performed, and stated that the two first classes were performed, more or less perfectly, by all known constructions of triple valves, as they existed prior to Mr. Westinghouse's invention. Then I went on to state as follows:

"The present invention or the invention of the patent in suit has to do with the combining of certain devices with the old automatic system by means of which the additional or 'further function' requisite for 'quicker and more efficient action of the brakes is obtained,' which function covers the third class of work above referred to, viz., 'emergency stops,' and these three classes of work are performed when occasion requires by the use of substantially the same means, each class of work being performed as desired by simply varying the manner of using such means."

Mr. Church, in his answer to said Q. 14, when referring to my classification of said three classes of work, says regarding me, as follows:

"He has entirely ignored the action of the ordinary triple valve *when used in an emergency* or when 'automatically' operated to apply the brakes with maximum power in the shortest possible time."

As a matter of fact, I did not ignore the use of an ordinary triple valve as he states. There is no pretense, as I understand Mr. Church, upon his part, or of any one else connected with this case, that there is any such operation possible with the ordinary triple valve as to cause one triple valve to quicken the action of the next succeeding triple valve, and thus cause the application of the brakes in a shorter or quicker time, as set forth by me in my former deposition, and, so long as this is the case, there was no occasion whatever for me to refer to the automatic application of the brakes in systems where triple valves proper alone were used, and Mr. Church's reference to it would seem to be only for the purpose of misleading the court, as it had nothing whatever to do with my classification of work in my former deposition.

Mr. Church, in his said answer to Q. 14, says as follows:

"In referring to the defendants' quick-action triple valve, Mr. Newbury has again ignored the third class of work, to wit: 'emergency stops,' as properly belonging to the triple valve proper. Defining the triple valve proper as one capable of performing the two classes

of work which he calls 'graduating' and 'service stops' (which classes of work I have termed 'graduating,' inasmuch as they are performed through the medium of the graduating valve, or the main valve when operated to partly or temporarily uncover its port), he has selected the graduating valve 40 of defendants' 1891 catalogue, and the graduating valve 13 of defendants' 1889 catalogue, and, properly attributing those two classes of work to the performance of said graduating valve, he has undertaken to say that said graduating valves are the main valves, and that the valve 22 is a valve auxiliary to *his so-called main valve*, whose function it is to open communication between the train-pipe and the brake-cylinder."

Mr. Church then states that he most emphatically disagrees with me on this point, and goes on to state his reasons.

It is true that what Mr. Church has seen fit to assume was meant by "emergency stops," when that term was used by me in my former deposition, was ignored by me when considering defendants' quick-action triple valve, and very properly done so by me for the simple reason that Mr. Church's assumed "emergency stops" are something entirely different from what I explained my third class

of work and designated emergency stops to be. Mr. Church
307 does not make the slightest attempt to show that a "quick-action or emergency application of the brakes," as he has seen fit to term my third class of work, is performed by the ordinary triple valve or "triple valve proper" as it existed prior to 1887, and, therefore, according to his own showing, such third class of work should be ignored as properly belonging to the triple valve proper or plain triple valve, as the same is more generally known.

Referring to the last quoted statement of Mr. Church, I would say that I am unable to find in defendants' 1891 catalogue, any valve designated by the numeral 40, or any designation whatever in connection with the quick-action triple valve shown in plate XI of that catalogue, which is as high in number as 40.

Adjourned to Thursday, November 30, 1893, at 9.30 a. m.

NOVEMBER 30, 1893—9.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of HENRY F. NEWBURY resumed:

(A. to Q. 233 continued:) The only valve which can be used in a graduating application of the brakes, in defendants' quick-action triple valve shown in plate XI of defendants' 1891 catalogue, is the ports and passage in what I have termed the main valve of that mechanism, and which I marked with the designating characters *i*, *k*, and *j* in my former deposition. These ports *i*, *j* and *k* are in that portion of said main valve designated as 18, and they operate in conjunction with that portion of the main valve which controls communication between the brake-cylinder and the atmos-

308 phere, and therein designated as 17. The valve 22 of said defendants' quick-action triple valve simply acts as a parti-

tion and not as a valve, when such quick-action triple valve is used as a triple valve proper.

I understand that the valve to which Mr. Church applies the designating numeral 40, is the same as the part of the main valve to which I have applied the designating characters *i, j, k*, which valve is used not only when "graduating" or making a "graduating application of the brakes" but also when making "service stops" or "service-stop applications of the brakes."

It will be observed that in the above quotation, Mr. Church says that I "properly attributed those two classes of work to the performance of said graduating valves," from which I understand that Mr. Church admits that the two classes of work which I termed "graduating" and "service stops" are properly attributed to the said graduating valves, and even according to Mr. Church's own description of defendants' quick-action triple valve, there would be required, in connection with his so-called graduating valve, the use of what he has termed the release valve, in order that either a graduating or service-stop application of the brakes be made.

If such two classes of work are properly attributed to said so-called graduating valve and release valve, as Mr. Church in substance states, then Mr. Church must agree fully with me that the functions of a "triple valve proper" are performed by such two valves, and therefore, such valves are the main valves of defendants' quick-action triple valves illustrated in plate XI of defendants' 1891 catalogue.

Mr. Church also says in said quoted statement, that I have undertaken to say that said graduating valves are the main valves, and that the valve 22 is a valve auxiliary to my so-called main valve, whose function it is to open communication between the train-pipe and the brake-cylinder.

It is true that I not only undertook to say, but that I did
309 say, and do now say, that said graduating valves, (which of course includes Mr. Church's so-called release valves) are the main valves of said defendants' quick-action triple valves, and such valves perform the functions of a triple valve proper, as I have heretofore shown, and because such is the fact they are necessarily the main valves of said defendants' quick-action triple valves.

It is also true that I did say in my former deposition, and now say, as I have heretofore repeatedly done, that the valve 22 of said defendants' quick-action triple valves is a valve auxiliary to the main valves of those mechanisms, whose function is to open communication between the main air or brake pipe and the brake-cylinder. The reasons why I have heretofore said that the valve 22 of said defendants' quick-action triple valves, is a valve auxiliary to the main valves of those mechanisms, I have heretofore given at length, and, therefore, will not again repeat them, but will simply say that if I have properly attributed the two first classes of work heretofore designated by me to the said graduating valves, including of course the so-called release valve, as Mr. Church states, then it necessarily follows that the valve 22 of said defendants' mechanism is a valve auxiliary to the main valves thereof.

If I properly attributed my two first classes of work to the said graduating valves, of course including the so-called release valves, as Mr. Church states, then every reason which Mr. Church gives for his opinion is necessarily of no weight or importance, and would simply go to show that such reasons were immaterial and of no weight in comparison with the statement above made by Mr. Church; for, if I properly attributed my first two classes of work to the said graduating and release valves, the facts that Mr. Church refers to as the reasons for his opinion have no real bearing upon the matter, and I will not further refer to such reasons of Mr. Church.

Mr. Church is asked, in Q. 15, as follows:

310 "Is a braking force, which is just sufficient to stop a train of cars running at a given speed on a level track, sufficient to stop the same train, running at the same speed, on a downgrade?"

To this question Mr. Church answers

"No; and this illustrates the absurdity of Mr. Newbury's classification of work performed by the ordinary triple valve," &c.

I am entirely at a loss to see anything in connection with this question which would illustrate anything absurd about my classification of work as heretofore made.

It would as well illustrate the absurdity of calling a graduating application of the brakes such, because, as a matter of fact, the braking force which would be a graduating application of the brakes, according to Mr. Church, when upon a downgrade, would necessarily be a service-stop application of the brakes when used upon an upgrade, but I must admit that I cannot see the slightest absurdity in these facts.

Every person having the slightest knowledge of the application of brakes to the wheels of cars, fully understands that, under varying circumstances, varying degrees of force must be employed, in order that the same result shall be obtained, and this is all there is that I can see in said Q. 15 and the answer thereto, and there is, as before stated, nothing which in any way would tend to illustrate any absurdity whatever in the classification of work as made by me, any more than it would be absurd as to the classification of the work made by defendants' experts, including Mr. Church.

234 Q. The specification of complainants' patent 360,070 contains the following disclaimer, to wit:

"I am aware that a construction in which 'an always-open one-way passage' from the main air pipe to the brake-cylinder is uncovered by the piston of the triple valve simultaneously with
311 the opening of the passage from the auxiliary reservoir to the brake-cylinder, has been heretofore proposed, and such construction, which involves an operation different from that of my invention, I therefore hereby disclaim."

State whether or not you find either of defendants' quick-action triple valves (plate IX defendants' 1889 catalogue of plate XI defendants' 1891 catalogue) to be within the terms of said disclaimer, and state also, by reference to the certified copy of file-wrapper and contents of patent 360,070, the circumstances under which said disclaimer came to be made?

The last clause of the question commencing with the words "and state also" is objected to, on the ground that the record itself shows the circumstances under which the disclaimer was entered, and is therefore the only competent evidence thereof, and it is presumable that the witness knows nothing about said circumstances, except what he has learned from said record, and is therefore incompetent to testify on the point.

A. I do not find either of said defendants' quick-action triple valves (plate IX defendants' 1889 catalogue or plate XI defendants' 1891 catalogue) to be within the terms of said disclaimer, because the construction referred to in said disclaimer is one in which the "always-open one-way passage" is to be at all times open to the same extent, and is not to be any more obstructed at one time than it is at another; therefore, said defendants' quick-action triple valves, which have a passage that is not always open to the same extent when the port leading to the brake-cylinder is open, but which have such passage obstructed and not open for the greater portion of the time, do not have an "always-open" passage, and are not within the terms of said disclaimer. In defendants' quick-action triple valve illustrated in plate IX of said 1889 catalogue, the port leading to the brake-cylinder is opened by the portion of the main valve therein designated as 13, but by me also designated as 18, at which time there is not an always-open passage from the main air or train pipe to the brake-cylinder, because such passage is closed during the time that the port leading to the brake-cylinder is opened by this valve.

In defendants' quick-action triple valves illustrated in plate XI of defendants' 1891 catalogue, the port leading to the brake-cylinder is open, whenever the triple-valve piston and its connected stem is moved backward enough to bring the port *i* in open communication with the chamber C, and at this time, in said defendants' quick-action triple valves, there is not an open passage between the main air or brake pipe to the brake-cylinder, for the reason that this passage is closed during the time that the port leading to the brake-cylinder is so opened by this port *i*.

Because of these facts, the said defendants' quick-action triple valves do not contain an always-open one-way passage leading from the main air or brake pipe to the brake-cylinder.

Referring to the file-wrapper and contents of the patent in suit, I find that the same communication which inserted the above-named disclaimer in the patent in suit, also cancels certain matter in the specification of the application as it then stood. This matter so canceled reads as follows:

"Further, while in the specific construction described and shown, the function of admitting air from the main pipe is performed by a valve separate from that which effects the preliminary admission of reservoir pressure to the cylinder, a modification in which the same office is performed by a valve integral with the main valve and formed by an extension thereof, would be included in and embody the essential operative features of my invention."

313 I would here state that, near the beginning of my investigation in connection with the quick-action system of brakes, I had occasion to investigate the file-wrapper and contents of the patent in suit No. 360,070 in the Patent Office in Washington, and at that time, became aware of not only the circumstances under which the said disclaimer was inserted, but also that the above-quoted statement was stricken or erased from the application for the patent in suit.

When I was called upon to testify in this case, something over two years since, I gave such matter careful consideration in connection with said defendants' quick-action triple valves, and, while, in each of said quick-action triple valves, the function of admitting air from the main air or train pipe is performed by a valve separate from that which effects the preliminary admission or reservoir pressure to the brake-cylinder, nevertheless I had the matter so stricken or erased from the specification wholly in mind, when I gave my former testimony in this case, as well as while giving my present deposition, and have, at all times, been of the understanding that a quick-action triple valve, in which the function of admitting main air or train pipe pressure directly from the main air or train pipe to the brake-cylinder, was performed by a valve which was integral with the main valve, and formed by an extension thereof, would be included within the invention of the patent in suit, because it would embody the essential operative features of such invention.

Or, in other words, the essential operative features of the invention would be the same when a valve composed of a single piece of material, controlled a port or ports leading from both the auxiliary reservoir to the brake-cylinder, and directly from the main air or train pipe to the brake-cylinder, and was adapted to so control such ports that the three classes of work heretofore referred to by me would be performed in the manner set forth, as would be the case when such ports or passages are controlled by valves composed of two separate pieces of material, which two valves controlled such two ports in a similar manner for performing the same three classes of work.

314 235 Q. In view of the official letters in the application for patent 360,070, as shown by the copy of file-wrapper and contents in evidence, to what, if any, prior patent do you understand the disclaimer quoted in Q. 234 to more particularly relate?

Objected to as immaterial.

A. I understand that the disclaimer was called for by patent No. 280,285, granted to G. A. Boyden, June 26, 1883, and therefore that said disclaimer relates more particularly to the said Boyden 1883 patent than to others which may be within the terms of said disclaimer.

236 Q. To what extent, if at all, do you find the modification referred to in the matter canceled from the specification filed in the application for patent 360,070, as quoted by you in your answer to

Q. 234, to be shown, described, or suggested in said Boyden patent No. 280,285?

A. There is nothing whatever, in the said Boyden patent No. 280,285, which in any way suggests or hints at a construction which would be the modification or equivalent thereof, referred to in the matter canceled from the application for patent 360,070, as quoted by me in answer to Q. 234.

Cross-examination by LYSANDER HILL, Esq., of counsel for defendants:

236 X Q. Referring to the defendants' quick-action air-brake apparatus, as illustrated in plate XI of defendants' 1891 catalogue and plate IX of defendants' 1889 catalogue, what do you understand to be the functions of the partition 9 of that apparatus?

A. I understand the functions of the so-called partition 9, of said defendants' quick-action triple valves, to be that of furnishing a means of protecting the triple-valve piston from a too sudden
315 reduction of auxiliary reservoir pressure by the expanding of the same too quickly or suddenly into the brake-cylinder, and, by so doing, to cause the triple-valve piston to close communication between the auxiliary reservoir and the brake-cylinder, and to also open communication between the brake-cylinder and the atmosphere before the desired application of the brakes is made.

In addition to the above, the particular part or piece of material which is designated as 9, and here referred to as the partition, also serves the function of supporting and guiding the triple-valve piston in its movement back and forth, by the contact of such part with the triple-valve piston.

This particular part or piece of material, designated as 9, forms only a portion of the partition between the triple-valve piston and the brake-cylinder, as said defendants' quick-action triple valves are illustrated in said plates of defendants' catalogues.

The actual partition in said defendants' quick-action triple valves, as the same are illustrated in said plates of defendants' catalogues, contains a restricted port or passage which restricts or retards the expansion of auxiliary reservoir pressure while such pressure enters the brake-cylinder; therefore the partition itself, between the auxiliary reservoir side of the triple-valve piston and the brake-cylinder itself, must serve the function of restricting or retarding the passage of auxiliary reservoir pressure while the same is passing to the brake-cylinder, by reason of providing such restricted port or passage which performs this retarding or restricting work.

237 X Q. Have you, in your last above answer, fully described and explained all the functions of said partition 9 in said defendants' apparatus?

A. I have described all that I call to mind at this moment; of course understanding the partition 9 to be something more than simply the piece of material designated as 9 in said defend-
316 ants' 1891 catalogue, and the corresponding piece of material designated by me as 9 in said defendants' 1889 catalogue.

238 X Q. What do you mean when you say, "of course understanding the partition 9 to be something more than the simple piece of material designated as 9, in said defendants' 1891 catalogue, and the corresponding piece of material designated by me as 9 in said defendants' 1889 catalogue"?

A. I mean, of course, the partition between the auxiliary reservoir side of the triple-valve piston and the brake-cylinder, the piece 9 being only a small part of such partition.

The merest glance at said defendants' 1891 and 1889 catalogues discloses the fact that the piece 9 forms only a small part of such partition, and furthermore, the restricted port or passage through such partition is not through the piece 9, but is elsewhere located, and this restricted port or passage could be differently located from what is there shown, and yet have such partition and restricted port or passage perform every function they now perform, and perform such functions in precisely the same manner as now.

Boyden patent 481,135, when referring to the part designated as 9 in defendants' quick-action triple valve, as the same is illustrated in the drawings of said patent and plate XI of defendants' 1891 catalogue, calls it "a brass bushing 9, which serves in part as a partition and separates the piston chamber D from the valve chamber C."

The specification of the said Boyden patent then goes on to say :

"A small passage B opens in the present instance between the piston chamber B and the valve chamber C, and forms a communication through which air from the auxiliary reservoir is admitted to the valve chamber C, and *vice versa*."

From this it will be seen that the part designated as 9 does not, of itself alone, form the partition which contains the restricted port or passage, and that such partition is composed of something
317 more than such part 9, and this is what I meant in my previous answer.

239 X Q. You say that the partition is composed of something more than the part 9; state all that it includes, according to your understanding?

A. The "partition" includes everything which forms a wall between the auxiliary reservoir side of the triple-valve piston and the auxiliary reservoir on one side, and the valve chamber and brake-cylinder upon the other, and any part of which when removed would open communication between the auxiliary reservoir, or auxiliary reservoir side of the triple-valve piston, and the valve chamber or brake-cylinder, or, in other words, all those portions of material in said defendants' quick-action triple valve which compel auxiliary reservoir pressure to pass through the restricted port or passage provided in this partition.

240 X Q. Please name, specifically, each and every part that enters into and forms a portion of the device that you call the "partition" in question?

A. I cannot do so any more specifically than I have already done, and I think it is perfectly plain what the wall is to which I have referred in the said defendants' catalogues, and in order to specify

these parts, I should have to so cover up the said plates in said catalogues as to render the designating characters and marks already upon them either unintelligible or so confused as to interfere with their being understood.

In order to make my meaning more clearly understood, I would say that all portions of the walls of the passage A, in plate XI of defendants' 1891 catalogue, which are between such passage A and the valve chamber or brake-cylinder passage, are necessarily included within said partition, and if an opening were made between such passage A and the valve chamber C, of the size of the passage A, in addition to the restricted port or passage, it would simply destroy the effectiveness of such partition and render the mechanism useless as a quick-action triple valve, although, as I understand the matter, the mechanism would be capable of performing every function of a triple valve proper.

From what I have said, I think it will be apparent that the metal composing the casing or chest which supports and holds the various parts of such defendants' quick-action triple valves, in part form this partition, and hence the difficulty in specifying each and every part that enters into and forms a portion of the device which I call the "partition."

Defendants' experts have had considerable to say, in their depositions, regarding a partition with a restricted port or passage through it, and have designated such partition as 9, but it is manifest, upon the merest glance at plates IX and XI of defendants' 1889 and 1891 catalogues, that the part there designated as 9, which is the brass bushing before referred to, is not the "partition" which is provided with a restricted port or passage, as described by defendants' witnesses, and, so long as this is the case, it would seem that it was perfectly understood what the said partition was, and also what composed it, at least I had no difficulty in understanding what the partition was, to which defendants' experts referred as being provided with a restricted port or passage, by means of which the flow of auxiliary reservoir pressure to the brake-cylinder was restricted or retarded as described by them.

I would gladly comply with the request of counsel, if I could do so any more specifically than I have already done, but I do not see how I can. I have made the above explanation so that the difficulties of the case may be understood.

241 X Q. Do you regard the side walls of the chamber C as forming a part of the "partition" in the sense in which you use the term in your deposition?

A. No, I do not regard all of the side walls of the chamber C as a part of the partition, because it is manifest, I think, that the side walls of such chamber C may be considered distinct from such partition, that is, the particular portions of metal which go to make up the side walls of the chamber C may be omitted entirely from said partition, and such partition be made up of the metal immediately adjoining such side walls and the passages leading to the auxiliary reservoir and auxiliary reservoir side of the triple-valve piston and the brake-cylinder.

This simply goes to show the impossibility of designating the specific portions of metal which I consider the "partition" before referred to, which partition, it will be remembered, is to be provided with a restricted port or passage.

242 X Q. Do you regard the walls of the port or passage governed by the valve 22 as forming any portion of the "partition" in the sense in which you use the term?

A. In the specific construction shown in defendants' quick-action triple valves, as the same are illustrated in the plates IX and XI of defendants' 1889 and 1891 catalogues respectively, the metal forming the immediate walls of the port or passage controlled by said valve 22, I would not consider as a portion of the wall or "partition" heretofore referred to.

To make my position more clear, in regard to the matter inquired about in the present question, as well as in the preceding one, I would say that the walls of the said chamber C, referred to in the preceding question, as well as the walls of the port or passage controlled by the valve 22, might be composed of an independent piece of material from that which composed the walls of the triple-valve piston chamber and the passages or ports leading to the auxiliary reservoir, and that these several parts might be so arranged, relatively to each other, that the walls of said chamber C, and port or passage controlled by the valve 22, could not form any portion of the partition before referred to, unless it might possibly be the immediate part of such walls of the chamber C which connects it with the piston chamber of the triple valve proper, and such portion might be almost infinitesimal.

243 X Q. Do you regard the said "partition," in the sense
320 in which you use the term, as functioning to divide the chamber C from the interior chamber of the brake-cylinder?

A. As I understand the present question, it would seem that that said "partition," in the sense in which I use the term, or the sense in which that term has been used by defendants' experts, is not used as functioning to divide the chamber C, which is the valve chamber, from the interior chamber of the brake-cylinder specifically, although, of course, I can conceive of constructions in which the partition would serve such a purpose, and would necessarily so serve it, because of the location of the passages leading to and from the valve chamber and the auxiliary reservoir, and from the latter to the brake-cylinder, therefore, it would depend wholly upon circumstances, whether, as a matter of fact, the said partition did functionate to divide the valve chamber from the interior chamber of the brake-cylinder.

If the question is intended to ask whether the partition provided with the restricted port or passage which restricts or retards the flow of auxiliary reservoir pressure to the brake-cylinder, is necessarily composed of any part or portion of the material which forms a partition between the valve chamber C and the interior of the brake-cylinder of said defendants' quick-action triple valves, then I would answer that I do not consider that any portion of the partition to which I have referred, and which has in it the restricted

port or passage, as stated, functionates to divide the valve chamber C from the interior of the brake-cylinder, in said defendants' quick-action triple valves.

244 X Q. From what does the "partition" separate or divide the valve chamber C, in the sense in which you use the term?

A. From the auxiliary reservoir and triple-valve piston chamber, so far as the chamber C itself is concerned.

245 X Q. Then you agree with the statement found in
321 lines 95 to 97 of page 1, of the specification of Mr. Boyden's patent No. 381,135, where the specification states that the brass bushing 9 serves in part as a partition and separates the piston chamber D from the valve chamber C; do you not?

A. So far as the bushing 9 is concerned therein referred to, I do agree with such statement, and furthermore, have never for a moment disputed it. It will be remembered that I quoted such statement in answer to a former cross-question, explaining what I meant when I said that the "partition" was something more than simply said bushing 9, thereby giving the language of said patent in support of my understanding of what the said partition was, and that it was not composed in whole by said bushing 9.

246 X Q. Do you agree with defendants' experts, as to the purpose and function of the bushing 9, in the defendants' quick-action triple-valve apparatus?

A. I cannot say at this time whether I do or do not, for the simple reason that, as I remember their testimony at this time, it is very indefinite as to what their opinions are regarding the function of said "bushing 9."

I do remember that they state that if the bushing 9 were removed from said defendants' quick-action triple valves it would then destroy the effectiveness of the partition containing the restricted port or passage before referred to, or, at least, this is the substance, as I remember it, of their testimony.

The removal of such bushing 9, without the substitution of something else in its place, will, as I understand the matter, destroy the effectiveness of such partition, for the simple reason that it will remove a part of such partition, and thus destroy the effectiveness of it.

The making of an opening between the passage A and the piston chamber C, of the same size as said passage A, as before stated, and not removing the bushing 9, but leaving it in place, would also
322 destroy the effectiveness of such partition, and for the same reason, namely, that a portion of the partition would be removed so that there would be no longer a restricted port or passage of the character before existing.

To the extent that the removal of the bushing 9, without the substitution of something else in its place, would destroy the effectiveness of such partition, I agree with said defendants' experts.

247 X Q. Then you regard the presence of a "partition," separating the valve chamber C from the piston chamber D and the auxiliary reservoir, and provided with a restricted port or passage between the two chambers thus separated, as being necessary, in the

defendants' quick-action brake apparatus, to the performance of the quick-action function; do you not?

A. That would depend wholly upon circumstances not stated in the question, or, in other words, what the question is intended to ask and is not definitely stated therein.

The question seems to be limited to whether it is essential or material that the restricted port or opening should be specifically located between the triple-valve piston chamber D and the valve chamber C.

I do not regard it as material or essential that the restricted port or passage shall be located between the two chambers named, but, on the contrary, regard such specific location of the port or passage as wholly immaterial and non-essential, and that it might be located otherwise, relatively to the auxiliary reservoir and the chamber C.

In this connection, I will refer to Mr. Boyden's patent No. 481,135, which, it will be remembered, shows and describes the form of defendants' quick-action triple valves illustrated in plate XI of defendants' 1891 catalogue. Beginning at line 7, of page 2, of the specification of said Boyden patent, I find the following language regarding the location of this restricted port or passage. It is as follows:

"It is obvious the restricted communication by which auxiliary reservoir air flows to the valve chamber may open directly
323 between the auxiliary reservoir passage A and the valve chamber, as at B', in dotted lines."

This restricted port or passage thus located is shown in figure 3 of the drawings.

From this it will be seen that the specific location of such restricted port or passage is not essential or material, and therefore, with this understanding of the question, I should have to answer that I do not regard it essential or material.

With another understanding of the question, namely, whether I regard the presence of a partition separating the valve chamber C from the piston chamber D and the auxiliary reservoir, in the specific construction shown in said defendants' quick-action triple valves, which partition is provided with a restricted port or passage, which restricts or retards the flow of auxiliary reservoir pressure into the valve chamber C, as essential and material, in such specific construction of defendants' quick-action triple valves, then I would answer that I do consider such a partition with such a restricted port or passage so located as essential or necessary to the performance of the quick-action function of said specific construction of defendants' quick-action triple valve.

Defendants' counsel states that his question was intended to have the meaning referred to by the witness in the latter part of his answer commencing with the words "With another understanding of the question," and not to have the meaning referred to in that portion of the witness's answer preceding those words.

Adjourned to Friday, December 1, 1893, at 10.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Cross-examination of HENRY F. NEWBURY resumed:

248 X Q. Do you find in the structure described and illustrated in the Westinghouse patent in suit, No. 360,070, a partition separating the valve chamber that contains the slide-valve 14 and the graduating valve 29, on the one hand, from the auxiliary reservoir and the chamber of the triple-valve piston 12, on the other hand, said partition being provided with a restricted port or passage operating to restrict the flow of auxiliary reservoir air from the auxiliary reservoir into said valve chamber? From the statement of the specification of that patent, page 2, lines 70 to 74, I understand said valve chamber containing the slide-valve 14 and graduating valve 29, to be designated as chamber 24.

Objected to as immaterial.

A. "The partition" containing the restricted port or passage referred to in the patent in suit, is not located between the auxiliary reservoir and the valve chamber 24, but is otherwise located so as to perform the same functions that are performed by the partition and restricted port, heretofore referred to in connection with defendants' quick-action triple valve.

Owing to the fact that auxiliary reservoir pressure and main air or train pipe pressure unite at a somewhat different point to enter the brake-cylinder, in the quick-action triple valve shown in the patent in suit, from what the corresponding pressures unite to enter the brake-cylinder in said defendants' quick-action triple valve, the partition with its restricted port is somewhat differently located in the two kinds of quick-action triple valves.

325 In other words, the valve chamber of said defendants' quick-action triple valve, is made a portion of the passage or conduit leading directly from the main air or train pipe to the brake-cylinder, while in the valve chamber 24, of the mechanism shown in the patent in suit, this is not the case, and therefore, the partition with its restricted port can be differently located in one mechanism or quick-action triple valve from what it is in the other, and yet, in each case, perform the same function, that is, restrict or retard the flow of auxiliary reservoir pressure, at the time when main air or brake pipe pressure is to unite with the auxiliary reservoir pressure and enter the brake-cylinder, as in a quick-action or an emergency application of the brakes.

Therefore, while the partition, with its restricted port or passage, is present in the quick-action triple valve shown in the patent in suit, yet it is not located between the valve chamber 24 on the one hand, and the auxiliary reservoir and the chamber of the triple-valve piston 12, on the other hand. In fact, in the specific construction of the quick-action triple valve shown in the patent in suit, the location of the auxiliary reservoir, valve chamber, and

triple-valve piston chamber, is such that it would be impossible to locate any kind of a partition in position relatively to the several parts, as inquired about in the question. From an examination of the specific form of construction of the quick-action triple valve shown in the patent in suit, it will be seen that the valve chamber 24 connects the triple-valve piston chamber with the auxiliary reservoir; therefore, it would take an entirely different construction and arrangement of the parts, relatively to each other, in order to separate the valve chamber on the one hand, from the auxiliary reservoir and triple-valve piston chamber, on the other hand.

249 X Q. In your answer just given, you state, in substance, that said partition containing the restricted port or passage referred to, is found in the patent in suit No. 360,070; will you please point out, in said patent No. 360,070, the partition and the restricted port or passage contained in it to which you thus refer?

A. The partition, with its restricted port or passage, to which I referred in the patent in suit, is the same partition which I have heretofore pointed out in my direct examination as existing in said quick-action triple valve of the patent in suit, which partition, and its restricted port, correspond in function with the partition and restricted port found in defendants' quick-action triple valve, and to which I have heretofore referred at length. The function of the partition, and its restricted port, in each case, has to do with the third class of work, to which I have heretofore referred as emergency stops, or as quick-action or emergency-stop applications of the brakes. This function I fully explained in my direct examination.

This partition, with its restricted port, in the quick-action triple valve shown in the patent in suit, consists of the metal which divides the auxiliary reservoir, valve chamber 24, and triple-valve piston chamber 11, on the one hand, and the brake-cylinder upon the other, including, of course, the metal composing the slide-valve 14, with its restricted port or passage 35. This restricted port or passage 35 is brought into register with the port or passage 23, at the time that auxiliary reservoir pressure is to unite with main air or train pipe pressure to enter the brake-cylinder, and it is owing to the restricting or retarding of the flow of auxiliary reservoir pressure through this restricted port or opening, at that time, that the lower main air or train pipe pressure is permitted to enter the brake-cylinder, at the same time that the higher auxiliary reservoir pressure is also entering such cylinder. Or, in other words, this metal forming the partition in which the restricted port or passage 35 is located, causes the momentary differential pressures by which the lower main or train pipe air can enter the brake-cylinder at the same time that the higher auxiliary reservoir pressure is also entering it.

327 I described at length the operation of this partition and its restricted port, its location, and how it caused the momentary differential pressures in my direct examination, and will not repeat them here. It will be remembered that the specific form of quick-action triple valve shown in the patent in suit is to be attached at

its end to the auxiliary reservoir, as shown in Fig. 7 of the drawing, and this brings the auxiliary reservoir against the open end of the valve chamber 24, as the quick-action triple valve is illustrated in Fig. 2 of the drawings. The passage 23, 22, 16, 47, 48 conducts auxiliary reservoir pressure to the brake-cylinder arranged at the other end of the auxiliary reservoir, as shown in Fig. 7 of the drawings. The triple valve, auxiliary reservoir, and brake-cylinder, in such Fig. 7, are designated as 10, 6, and 7 respectively.

250 X Q. If I understand you, then, you regard the port 35, of the Westinghouse patent No. 360,070, as being itself the restricted passage through the "partition;" am I correct?

A. Yes, so far as concerns the entrance of auxiliary reservoir pressure to the brake-cylinder, when making a quick action or emergency application of the brakes.

251 X Q. In the device of said Westinghouse patent in suit, does any auxiliary reservoir air flow through said restricted passage or port 35 to the brake-cylinder, in the act of making a graduating application of the brakes or a service stop?

A. No, it does not.

252 X Q. In the defendants' apparatus, which is alleged to infringe the Westinghouse patent in suit, the auxiliary reservoir air flows through the restricted passage B, into the valve chamber C, and thence to the brake-cylinder, in the act of making a graduating application of the brakes or a service stop, as well as in the act of making an emergency or quick application of the brakes, does it not?

A. It does, because the valve chamber is made a portion of the direct passageway, conduit, or port, through which the direct admission of main air or train pipe pressure is made to the brake-cylinder, and at such time, that is, when this direct admission of main air or train pipe pressure takes place, such valve chamber is in wide open communication with the brake-cylinder, and, so far as the admission of air or pressure is concerned, is a part of such brake-cylinder.

This is one of the differences, to which I have heretofore referred, between defendants' quick-action triple valves and the quick-action triple valve shown in the patent in suit, growing out of the fact that the main air or train pipe pressure and auxiliary reservoir pressure unite at a somewhat different point in one case from that at which the corresponding pressures unite in the other case.

As a matter of fact, the port 35 might be arranged in the slide-valve 14 so that auxiliary reservoir air would necessarily flow through such port, when making a graduating or service-stop application of the brakes, as well as when making a quick-action or emergency application of the brakes. I mention this fact simply to show that the location of the port 35, as it now appears in the quick-action triple valve shown in the patent in suit, might be changed from that there shown, and yet that there would be no difference in the operation of the parts as a whole, either when making a graduating service stop or an emergency application of the brakes, and without otherwise changing the mechanism.

253 X Q. In the structure of the complainants' patent No. 360,070, it is necessary that the restricted passage 35, leading from the valve chamber 24 to the brake-cylinder, be a passage through a valve or a passage controlled by a valve; is it not?

A. In the specific form of mechanism shown in the drawings of said patent, it is necessary that the restricted port leading from the valve chamber to the brake-cylinder be a port or passage through a valve or a passage controlled by a valve, but this is due wholly to the specific form of quick action triple valves used in the drawings of said patent to illustrate the invention of the patent in suit.

329 254 X Q. In the apparatus of complainants' patent No. 360,070, why is it necessary that the passage which you term a restricted passage should be controlled by a valve?

A. Because of its specific construction, that is, the valve chamber 24 is in wide open communication with the auxiliary reservoir.

255 X Q. Is it not, rather, because the passage through which the air is admitted directly from the train-pipe to the brake-cylinder, in the act of making a quick application of the brakes, leads around the triple-valve chamber 24, and that part of the piston chamber 11 which lies between the piston 12 and the chamber 24?

A. No, I do not think it is, because the specific construction might be changed in respect to the portion of the passage inquired about, and yet have the necessity remaining (when the construction of valve chamber and auxiliary reservoir remains the same), for the port or passage to be either through a valve or controlled by a valve.

256 X Q. I shall have to ask you to make your meaning a little more clear, as I do not understand your last answer.

A. "The portion of the passage inquired about" in my previous answer referred to the portion of the passage leading around the triple-valve chamber 24 and that part of the piston chamber 11 which lies between the piston 12 and the chamber 24 referred to in the preceding question. The port or passage to be either through a valve or controlled by a valve, referred to in the latter part of my preceding answer, of course, refers to the port or passage referred to in the questions and answers which precede X Q. 255.

257 X Q. In the structure of the Westinghouse patent No. 360,070, what would be the result if, in the act of attempting to make an emergency stop, the air pressure in the valve chamber 24 should be suddenly reduced to the same extent that the air pressure in the corresponding valve chamber C of the defendants' 330 apparatus is reduced in the act of making an emergency stop or quick application of the brakes?

A. It will be remembered that the valve chamber 24 does not correspond wholly with the valve chamber C of said defendants' quick-action triple valve, for the simple reason, as heretofore explained, that the auxiliary reservoir and main air or train pipe pressures unite in the valve chamber C to enter the brake-cylinder, while such chamber is in wide open communication with and substantially a part of the brake-cylinder, while this is not the case in

the valve chamber 24 of the quick-action triple valve shown in the patent in suit, or in other words, the valve chamber C, of defendants' quick-action triple valve, forms a portion of the passage, conduit, or port, through which the direct admission of main air or train pipe pressure is made to the brake-cylinder, while such is not the case in the quick-action triple valve shown in the patent in suit. If the air pressure in the valve chamber 24 should be suddenly reduced below the main air or train pipe pressure upon the other side of the triple-valve piston, of course the triple-valve piston would at once move forward, shutting off all communication between the auxiliary reservoir and the brake-cylinder, and at the same time opening communication between the brake-cylinder and the atmosphere and thus releasing the brake. Of course, if the triple-valve piston had been moved far enough to open the valve 41 in its backward movement, such piston, when it moved forward, as above described, to release the brakes, would permit the valve 41 to be closed by the action of the spring which moves it in one direction, namely, the closing direction.

258 X Q. It is a fact, then, is it not, that in the defendants' apparatus, the sudden and great reduction of air pressure in the valve chamber C causes the air to flow directly from the train-pipe to the brake-cylinder and effect the "quick action," whereas, in the apparatus of the patent in suit, No. 360,070, a like reduction of air pressure in the valve chamber 24, which corresponds to the 331 Boyden valve chamber C, would both defeat the quick-action application of the brakes and release the brakes?

A. The question, as I understand it, assumes that said defendants' quick-action triple valves are to remain in the same condition that they are in now, while the quick-action triple valve shown in the patent in suit is to be changed in some mysterious way, not stated, so that a result may be attained not in any way contemplated by the patent in suit, and then, the question goes on to ask me whether the operation of the two mechanisms under these conditions would not be different.

The question assumes also that the valve chamber 24 is to correspond to the valve chamber C of defendants' quick-action triple valves.

Now, if the quick-action triple valve shown in the patent in suit is to be changed in some way, so that the pressure can be suddenly reduced in the valve chamber 24, and such chamber 24 is to correspond with the chamber C of defendants' quick-action triple valve, then, under such assumption, the result would be, so far as I can see, identically the same in each case, and there would necessarily be a quick-action application of the brakes, and not any such result as would defeat a quick-action application and release the brakes, in the assumed changed construction of the mechanism shown in the patent in suit. Therefore, it is not the fact that a similar sudden and great reduction of air pressure in the assumed structure, would, in the case of defendants' quick-action triple valves, effect a quick action, and, in the assumed structure, would both defeat the quick-action application of the brakes and release them.

I cannot conceive of any mechanism, at this time, which would permit a sudden reduction in the valve chamber 24 of the quick-action triple valve shown in the patent in suit and yet not destroy the mechanism for any useful purpose whatever. At least I do not call to mind any arrangement, at this moment, which would not produce this result.

332 259 X Q. As I understand you, in the action of the mechanism described and shown in complainants' patent No. 360,970, it is not possible to produce the sudden and great reduction of air pressure in the valve chamber 24 that is produced in the valve chamber C of the defendants' alleged infringing mechanism in the act of making a quick application; am I correct?

A. You are, as I have repeatedly stated this fact both in my former deposition and the present one.

260 X Q. In the defendants' said brake mechanism, it is the partition 9, with its restricted port B, that enables the air pressure to be thus suddenly and greatly reduced in the valve chamber C; is it not?

A. Understanding "the partition 9" to be the partition as I have heretofore explained, I will answer the question. It is the presence of a partition which may be designated as 9, with a restricted port or passage placed therein, which partition is located relatively to the auxiliary reservoir and piston chamber D, relatively to the brake-cylinder, as contained in said defendants' quick-action triple valves, which permits or enables the air pressure to be suddenly and greatly reduced in the valve chamber C of said defendants' valve, which chamber, as heretofore explained, is, at that time, in wide open communication with the brake-cylinder, and is also used as a portion of the direct communication between the main air or train pipe and the brake-cylinder.

The only time it is desired to greatly and suddenly reduce the pressure or air in the valve chamber C, is when the direct admission of pressure from the main air or brake pipe to the brake-cylinder is to be made, and, at this time, the chamber C is not serving the function of a valve chamber, but it is serving the function of admitting main air or train pipe pressure directly to the brake-cylinder, and, so far as such admission of main air or train pipe pressure directly to the brake-cylinder is concerned, the chamber C forms only a part of the passageway, conduit, or port, by means of which such direct admission of pressure is made.

333 It is true, as I have repeatedly stated, that the restricted port or opening in said partition at this particular time, serves the function of restricting or retarding the flow of auxiliary reservoir pressure to the brake-cylinder, so that the direct admission of main air or train pipe pressure can take place, and its only function is to so retard and restrict the flow of auxiliary reservoir pressure to the brake-cylinder at such time. It is of no use at any other time, and, therefore, when the said chamber C is serving its function of a valve chamber, the restricted port and partition is inert, and is only brought into useful work when said chamber C is serving the function of forming a part of the passageway, conduit, or port, from the

main air or train pipe to the brake-cylinder, by means of which the direct admission of air or pressure takes place from the former to the latter.

With this explanation, I would answer that it is the partition 9, with its restricted port B, that enables the air pressure to be suddenly and greatly reduced in the valve chamber C. Of course, it being remembered that, at this time, the valve chamber C is serving the function of a portion of the direct communication between the main air or train pipe and the brake-cylinder.

261 X Q. I understand from your last answer, that in the Boyden apparatus, the chamber C performs two functions, viz., the function of accommodating those valves which control the admission of air from the auxiliary reservoir to the brake-cylinder, and the function of forming a passage, or a portion of a passage, through which air is admitted directly from the train-pipe to the brake-cylinder in making the quick application of the brakes; do you find in the apparatus of the complainants' patent, No. 360,070, any chamber which performs these two functions?

A. I do not find in the mechanism shown in the patent in suit No. 360,070 any chamber performing the two functions named.
334 If I remember correctly, I have heretofore repeatedly pointed out this difference between the two kinds of quick-action triple valves.

262 X Q. In the defendants' alleged infringing mechanism, if the bushing 9 were omitted, would the sudden and great reduction of air pressure in chamber C, which causes the air to flow directly from the train-pipe to the brake-cylinder and effect the "quick action" in the apparatus as actually used with the bushing in place, then, in the absence of such bushing, cause the air to flow directly from the train-pipe to the brake-cylinder, and thus effect the "quick action"? In other words, in the defendants' brake apparatus illustrated in plate XI of their 1891 catalogue, would the sudden and great reduction of air pressure in valve chamber C which, as the apparatus is there shown, effects the "quick action," have the effect to cause the air to pass directly from the train-pipe to the brake-cylinder, in case the bushing 9 were omitted or removed?

A. As I understand the question, it is as follows: Would the removal of the bushing 9, shown in plate XI of defendants' 1891 catalogue, prevent the sudden reduction of pressure in the chamber C, which now takes place when such bushing is in place?

With this understanding of the question, I should answer that the sudden reduction in pressure which takes place when the said bushing 9 is in place, would not occur when said bushing was removed, and that this difference in the reduction of pressure in the chamber C is sufficient to prevent a direct admission of pressure of main air or train pipe pressure to the brake cylinder, through such chamber C, and, because of this, the "quick action" would not occur. The term "quick action," as used by me, and as I understand it to be used in the question, refers to the quick-action or emergency application of the brakes, wherein a direct admission of main air or train pipe pressure to the brake-cylinder takes place.

263 X Q. Assuming the bushing 9 to have been removed from the apparatus used by defendants, and illustrated in plate XI of their 1891 catalogue, state what would be the action of the apparatus upon the engineer's making such reductions of pressure in the train-pipe as he would ordinarily make in graduating; also as he would ordinarily make in applying the service stops; and, thirdly, as he would ordinarily make in attempting to stop the train in the shortest possible time or, in other words, in an emergency stop?

A. As I understand the question, it refers to the three classes of work which I defined in my former deposition, and which have been designated, by defendants' expert, as graduating, service-stop, and quick-action or emergency application of the brakes.

I should expect that the two first classes of work would be performed in substantially the same way, when the bushing 9 was removed, that such two classes are performed when such bushing is present. Of course, assuming that the triple-valve piston stem is provided with some means of properly guiding it back and forth, when moved by varying the pressures upon the two sides of the piston.

I should also expect that the third class of work would not be performed at all when the bushing 9 was removed.

I have had tests made with a quick-action triple valve, very similar to the one illustrated in plate XI of defendants' 1891 catalogue, and found that, with a single valve, the results were as above stated, and I should expect that the results would be as stated when quick-action triple valves, like those shown in plate XI of defendants' catalogue 1891, were placed upon each car of the train, with the bushing 9 removed, and the engineers' valve or cock manipulated in the ordinary way for performing the three classes of work heretofore referred to.

264 X Q. Then, if I understand you, the apparatus illustrated in plate XI of defendants' 1891 catalogue, in the absence of the bushing 9, would operate as a plain triple valve; am I correct?

336 A. You are, for the reason that the bushing 9, as heretofore explained, forms a part of the partition with the restricted port or passage, which is essential in quick-action triple valves, as before explained by me.

265 X Q. In your answer to X Q. 249 this morning, you undertook to point out or explain what you called the partition, with its restricted passage, in the structure illustrated in the Westinghouse patent in suit, No. 360,070; in that so-called partition of the Westinghouse structure, is there any part forming a portion of said partition which you can destroy or remove, and still have the apparatus perform all the functions of a plain triple valve.

A. Yes, I believe there is.

266 X Q. What is such part?

A. That part or portion which would be uncovered when the slide-valve 14 is in position to have the triple-valve piston open the valve 41, and which would be closed when said valve 14 was in

position to make a graduating and service-stop application of the brakes.

This would, in effect, give a pressure in the passageway, conduit, or port, leading directly from the main air or train pipe to the brake-cylinder, that would be high enough to overcome such main air or train pipe pressure and prevent its direct admission to the brake-cylinder.

267 X Q. Do you mean that you could make a hole through the casing, from the valve chamber 24 to the passage 46, in the Westinghouse apparatus shown in the patent in suit?

A. That is substantially what I mean, such hole being of somewhat greater capacity than the passage 46, so that there would be substantially the same pressure in the passage 46 that there is in the auxiliary reservoir or valve chamber 24.

268 X Q. Assuming such a hole, larger in area than the cross-section of the passage 46, to be made through the wall or casing of the triple-valve chamber 24 to the passage 46, where would you locate that hole in order to have it in position to be uncovered when the slide-valve 14 is in position to have the triple-valve
337 piston open the valve 41, and so that it would be closed when said valve 14 was in position to make a graduating and service-stop application of the brakes?

A. I would locate the said hole as described in a previous answer, which is as definite as I can locate it at the present time, that is, I would so locate such hole that it would be covered when the slide-valve 41 is in position for making a graduating and service-stop application, which, it will be remembered, is one and the same position, and also, so that such hole would be uncovered by the slide-valve 14 when the valve 41 is opened.

269 X Q. Can you not refer to figure 2 of the drawings of patent 360,970, which shows said slide-valve, and the wall or casing upon which it slides, illustrated in section, and point out just where you would locate that assumed hole?

A. The said figure 2, it will be observed, is taken on a section line which does not show the passage 46, and for this reason any designating mark that I might put on said figure 2 might be misleading, and furthermore, would not show the capacities of the hole and passage, as that would depend upon something which it is impossible to show on said figure 2.

270 X Q. You state that the hole would be so arranged as to be uncovered when the slide-valve 14 is in position to have its piston open the valve 41, and would be covered when the said valve 14 was in position to make a graduating and service-stop application; when the slide-valve 14 was in the latter position, covering the imaginary hole, the "partition" would be intact and no part of it removed so as to allow communication between the chamber 24 and the passage 46, would it not?

A. The partition would have a part of it removed, as much as would the partition in said defendants' quick-action triple valve when the bushing 9, which makes up a part of the partition of said

338 defendants' quick-action triple valve, at the time that the said defendants' valves were to be used when making a quick-action application of the brakes was removed, and the removal of the part of the partition of each quick-action triple valve produces a similar result, that is, preventing the direct admission of main air or train pipe pressure to the brake-cylinder, by reason of the higher auxiliary reservoir pressure existing in the passage-way, conduit, or port, through which such direct admission of pressure takes place.

In each case auxiliary reservoir pressure must be shut off from the brake-cylinder, except through the port by which the graduating and service-stop application of the brakes must be made; therefore, the partition in the quick-action triple valve shown in the patent in suit, with the assumed hole, would not be intact and no part of it removed, because, if such was the fact, there would be no change whatever in the operation of the mechanism from what it is as shown in said patent.

It is true that the auxiliary reservoir pressure is cut off from the brake-cylinder, when a graduating and service-stop application of the brakes is to be made by the covering of such hole with the slide-valve 14, but, notwithstanding this fact, the "partition" is not intact, and an essential and material portion of it is removed.

271 X Q. But you state that, during the operations of graduating and making service stops, you would have the valve 14 cover your imaginary hole, so as to prevent air from passing through it from chamber 24 to passage 46; during such time, when the hole was so covered by the valve, your so-called "partition" would be just as complete and effective as a partition, as if the hole did not exist, would it not?

Adjourned to Saturday, December 2, 1893, at 10.30 a. m.

339 NEW YORK, *December 2, 1893*—10.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Cross-examination of HENRY F. NEWBURY resumed:

A. to X Q. 271. What counsel is pleased to term my "so-called partition" is, as has been repeatedly explained, a partition with a restricted port or passage, which partition, with its port or passage, is located between the auxiliary reservoir and the brake-cylinder, and is useful only, so far as the restricted port or passage is concerned, during the time that a quick-action or emergency application of the brakes is to be made.

In order that the quick-action triple valve shown in the patent in suit shall be of any use whatever in applying the brakes, the auxiliary reservoir must be, at least when making a graduating or service-stop application, separated from the brake-cylinder, except by the usual connections, otherwise the mechanism would be entirely worthless for any useful purpose that I call to mind at this time.

In this respect, there is no difference whatever between the quick-action triple valve shown in the patent in suit and defendants' quick-action triple valve shown in plates IX and XI in defendants' 1889 and 1891 catalogues respectively.

The "imaginary hole" which removes the restricted port or passage from the partition in the mechanism shown in the patent in suit, would not be just as complete and effective as a partition as it would be if that hole did not exist, and, so far as the restricted port or opening is concerned, by means of which a quick-action application of the brakes is made, the partition is effectually removed at the only time that the restricted port or opening serves its function.

It is true that this imaginary hole is covered, at the time when the graduating or service-stop application is to be made, and
340 this is done by the movement of one part relatively to another, but this is also the case in said defendants' quick-action triple valve, so far as concerns the separation of the brake-cylinder from the auxiliary reservoir, which is the essential function of the partition with its restricted port or passage.

In each case, if the brake-cylinder were not separated from the auxiliary reservoir by a movable part, said defendants' quick-action triple valve would be as useless, for any purpose that I know of, as would be the case with the quick-action triple valve shown in the patent in suit, if the said imaginary hole were made without any provision for covering it, and thus separating the brake-cylinder from the auxiliary reservoir.

These several facts simply emphasize the similarity between the quick-action triple valve shown in the patent in suit and said defendants' quick-action triple valve, as well as illustrate the fact that, the partition with its restricted port or passage, of the mechanism shown in the patent in suit, is not as effective and complete, for the purposes which it is to serve, when the "imaginary hole" referred to in the question is present therein, as such partition and its restricted port are when the said hole is absent.

272 X Q. In the mechanism illustrated in defendants' 1891 catalogue, plate XI, if the bushing 9 be removed totally and permanently, you have testified that the apparatus will operate as a plain triple valve, but will not operate to produce "quick action." I asked you if there was any such partition in the apparatus of complainants' patent No. 360,070 which could be removed with like result. You replied that the imaginary hole which you have tried to describe could be made through the casing of the chamber 24, and so arranged relatively to the valve 14 that it would be exposed when said valve was in a position to make a quick application, and covered when said valve was in a position to make a graduating or service-stop application. In other words, you try to describe a partition which can be removed at one portion of the movement of the valve, and restored by another portion of the movement
341 of the same valve. Now I ask you whether, in the apparatus of the patent in suit, you find any partition or part of the partition that can be permanently removed and allowed to remain

removed, (just as the bushing 9 of the Boyden apparatus can be removed and allowed to remain removed) with the result that the said Westinghouse apparatus will then be capable of performing all the functions of a plain triple valve, but will not be capable of performing the quick-action function?

By the words "such partition," in the second sentence of this interrogatory, I mean any part forming a portion of your so-called partition in the apparatus of patent 360,070, which you can destroy or remove with like results as follows from the destruction or removal of the bushing 9 of the Boyden apparatus.

A. The statements which precede the question do not seem to me to be correct statements of the facts. I will call attention to the statement, wherein it says, in substance, I "try to describe a partition which can be removed at one portion," &c.

I not only tried to describe such a portion, but I think, as a matter of fact, I did describe it.

I also believe that I have already fully answered the present question, but have not the slightest objection to answer it over again, and will do so in different language.

The "bushing 9" heretofore referred to in connection with said defendants' quick-action triple valves, and the removal of which prevents said defendants' quick-action triple valve from making a quick-action or emergency application of the brakes, is simply a part of the partition provided, with the restricted port or passage, to which I have heretofore referred. The removal of such bushing 9 removes a portion of such partition in the immediate vicinity of said restricted port or passage, so that the opening which formed this port or passage is no longer capable of restricting or retarding the flow of auxiliary reservoir pressure in its passage
342 or expansion into the brake-cylinder, owing to the fact that a larger opening has been made in its immediate vicinity.

The quick-action triple valve shown in the patent in suit, as I have heretofore explained, contains a partition with a restricted port or opening, which port or opening serves to restrict and retard the flow of auxiliary reservoir pressure, in its passage from the auxiliary reservoir to the brake-cylinder, when making a quick-action application of the brakes.

The removal of that part or portion of the partition, in the mechanism shown in the patent in suit, in the immediate vicinity of the restricted port or passage through such partition, and by such removal forming an opening into the passage 46 shown in said patent, which opening was to be of larger capacity than said passage 46, likewise produced an opening in the partition, by the permanent removal of a part of that partition, and such removal rendered the restricted port or passage incapable of restricting or retarding the flow of auxiliary reservoir pressure to the brake-cylinder, in precisely the same manner, and for precisely the same reasons that the removal of the bushing 9, in said defendants' quick-action triple valves, rendered the restricted port or passage of those valves, designated as B in plate XI of defendants' 1891 catalogue, ineffectual to restrict or retard the flow of auxiliary reservoir pressure to the

brake-cylinder of those quick-action triple valves, when making a quick-action or emergency application of the brakes.

The removal of the part of the partition, in one case, is as permanent and thorough a removal as it is in the other case, and the result is the same in each case, and one apparatus will be as capable of performing the functions of the plain triple valve as the other will, and because of the same reasons.

Because of these facts, I do find a part or portion of the partition containing the restricted port or passage in the quick-
 343 action triple valve shown in the patent in suit which can be permanently removed and be allowed to remain removed (just as the bushing 9 of the Boyden apparatus can be removed and allowed to remain removed) with the result that the said Westinghouse apparatus, or the apparatus shown in the patent in suit, changed as I have suggested, will then be capable of performing all of the functions of a plain triple valve, but will not be capable of performing the quick-action or emergency application of the brakes.

273 X Q. You speak of removing a part of your so-called partition, by forming the imaginary hole, and then you immediately proceed to cover the hole by the valve 14, during the graduating and service-stop position of said valve; does not the covering of the hole restore the partition and hold it restored while the valve is in position to make a graduation or service-stop application?

A. "The partition" to which you have been referring all the time, is a partition with a restricted port or opening, and to separate the restricted port or passage from the partition so that it is no longer the partition to which we have been referring, is to make a different partition altogether from the one containing such restricted port or passage.

This fact shows that the valve 14, in its movement, does not destroy "the partition," during the graduating and service-stop applications of the brakes, and therefore, the covering of the opening made by the permanent removal of a part of said partition, which opening counsel is pleased to term "the imaginary hole," does not restore such partition for the graduating and service-stop applications of the brakes.

The covering of this opening, made by the permanent removal of a part of the partition, is done by the usual movements of the mechanism, when performing the said graduating and service-stop applications of the brakes, and the most that can be said of it is, that it renders the apparatus serviceable while making such applications of the brakes, the same as the closing of chamber C
 344 from the brake-cylinder in said defendants' quick-action triple valves, by the ordinary movements of the parts in those mechanisms, renders them serviceable while making corresponding applications of the brakes. In each case, the closing of communication between the auxiliary reservoir and the brake-cylinder is by the ordinary movements of the other parts of the two kinds of mechanisms, and the permanent removal of a part of the partition containing the restricted port or passage, does not, in any way, affect

either kind of mechanism, when making a graduating or service-stop application of the brakes.

Of course, all of my references to the operation of the said defendants' quick-action triple valves, are to said valves when the "bushing 9" is removed, and said valves are operated as I have seen them operated, that is, so that the graduating and service-stop applications of the brakes are made without the opening of the valve 22, and also as they necessarily would have to be operated if such valves were operated by the use of an engineers' valve or cock of the ordinary construction and in the ordinary way.

274 X Q. You have delivered a long lecture, but have not answered my question, and I now repeat it: Does not the covering of the hole, which you have imagined in the casing of the Westinghouse apparatus, restore the partition, and hold it restored, while the valve 14 is in position to make a graduation or service-stop application?

A. I beg to differ with counsel as to his statement of the fact. I have fully answered his question, as I understand the matter, wherein I said "The covering of the opening made by the permanent removal of a part of said partition, which opening counsel is pleased to term 'the imaginary hole' does not restore such partition for the graduating and service-stop applications of the brakes."

Notwithstanding the fact that I have already answered the question once, I have no objection to answering it again, and will do so using different language.

315 The movement of the valve 14, by means of which the opening, which I have assumed to be made in the partition containing the restricted port of the mechanism shown in the patent in suit is closed, does not restore such partition and hold it restored, in such apparatus, while the valve 14 is in position to make a graduating or service-stop application of the brakes, and, for the very manifest reason, that the restricted port is not effective for restricting or retarding the flow of auxiliary reservoir pressure to the brake-cylinder, when a quick-action or emergency application of the brakes is to be made, that is, the movement of the valve 14 has nothing whatever to do with restoring the restricted port or passage to its functions in the said partition, and has nothing whatever to do with the restoration of a partition with such a restricted port or passage.

275 X Q. When you make a hole through a partition, and then cover and close the hole, do you not thereby, in effect, restore the partition and hold it restored so long as the cover remains in place to close the hole?

A. The present question seems to deal wholly with an abstract proposition, which has nothing whatever to do with the present case, so far as I understand the question.

Considering the matter wholly as an abstract proposition, I should have to answer that the question does not state facts enough to determine whether, in effect, the partition would be restored, and held restored, or not.

If the question is only intended to ask whether the hole in the assumed partition would be covered and closed, I should, of course, answer that it would, but whether the partition assumed in the question would be in effect restored or not, I am unable to state, until I see the mechanism in which that partition is located and know the functions of the partition.

276 X Q. If your imaginary hole in the partition, as you call it, of the Westinghouse apparatus of patent No. 360,070, were
346 not closed during the making of a graduation or service stop, would said brake apparatus perform the functions of a plain triple valve or not?

A. No, as I have repeatedly heretofore stated.

277 X Q. Then the imaginary hole which you would make in the so-called partition of the apparatus shown in the patent 360,070, is a hole which must be closed during the making of a graduation or service stop, and opened by the movement of the triple-valve piston to its extreme outward position, in order that said Westinghouse apparatus, with such assumed hole shall perform all the functions of a plain triple valve and not perform the quick-action function: am I correct?

A. The opening which I have assumed to be made by the permanent removal of a part of the partition provided with the restricted port or passage, of course is placed in such part of the said partition that it will not destroy the mechanism for any useful purpose whatever, as the same is illustrated in the patent in suit.

This is the case when we make a permanent removal of the "bushing 9" of said defendants' quick-action triple valves.

If this was not the case with both kinds of triple valves, then both mechanisms would be worthless for any useful purpose, and this is as true of one kind of mechanism as it is of the other.

The location of the opening at the particular point named by me, was due wholly to the specific details of construction of the mechanism used to illustrate the invention of the patent in suit.

In a mechanism having the specific details of construction of the mechanism shown in the patent in suit, and with the partition and the restricted port or passage, located relatively to the auxiliary reservoir, valve chamber 24 and piston chamber 11 on one hand, and the brake-cylinder on the other hand, as there shown, the part of such partition which is to be permanently removed in the formation of the opening, as described by me, is necessarily to be located so

347 that it will not interfere with the performance of the two first classes of work heretofore referred to by me, and to do this, such opening would also have to be located so that, in the ordinary operations of the mechanisms, the auxiliary reservoir would be shut off from the brake-cylinder except by the connections provided by means of which the graduating and service-stop applications of the brakes are made, and this requires that such hole or opening must be closed at the time when a graduating or service-stop application of the brakes is to be made.

Or, to state the matter in other words, the partition, with its restricted port or passage, in the mechanism shown in the patent in

suit, not only serves to separate the auxiliary reservoir and auxiliary reservoir side of the piston chamber from the brake-cylinder, but also serves to separate the valve chamber 24 from the brake-cylinder. Consequently, the restricted port or passage through such partition has to be closed, whenever a graduating or service-stop application of the brakes is to be made, and also when the brakes are off, and any part or portion of such partition which is to be permanently removed, must be located so that the opening made by such removal will be likewise closed when the brakes are to be off, and also when graduating and service-stop applications of the brakes are to be made.

This would not necessarily be the case if the auxiliary reservoir valve chamber 24, triple-valve piston 12, piston chamber 11, and brake-cylinder, were arranged somewhat differently from what they are now arranged, but still operating to perform the same work, in substantially the same way that the work is now performed, when these several parts are specifically arranged as shown in the patent in suit.

It will be observed that, in said defendants' quick-action triple valves, the auxiliary reservoir is shut off from the brake-cylinder, except by the connections provided by means of which a graduating or service-stop application of the brakes is to be made, at the time that the "bushing 9" is removed, and also, that the
 348 part which shuts off the auxiliary reservoir from the brake-cylinder, as thus set forth, namely, the valve 22, is wide open when an emergency or quick-action application of the brakes is to be made, and is so opened by the ordinary movements of the mechanism, and also, that such opening is closed again, by the ordinary movements of the mechanism, when the brakes are to remain off, and also when a service-stop or graduating application of the brakes is to be made, in order that said defendants' quick-action triple valves shall perform all of the functions of a plain triple valve, and also that this port, controlled by the valve 22, is opened by the movement of the triple-valve piston to its extreme outward position, at which time the quick-action function will not be performed.

With the above explanations, you are correct.

Answer objected to by defendants' counsel, as containing a mess of rubbish, totally irresponsive to the question.

278 X Q. The hole made in the Boyden apparatus by the removal of the bushing 9 does not have to be covered or closed during the graduating or service-stop application of the brakes, does it?

A. In effect it is closed, but not literally closed. That is, the portion of the partition which is removed is so located, relatively to the other parts, that it does not have to be literally covered when making a graduating or service-stop application of the brakes, but it does have to be covered, in effect, by the valve 22, so that such opening does not lead directly into the brake-cylinder.

In one form of defendants' quick-action triple valves, an opening could be made in the partition provided with a restricted opening,

which would necessarily have to be literally closed by the movements of the triple-valve piston, if the mechanism was to serve any useful purpose and be able of serving the functions of a plain triple valve.

I mention this fact simply to show that the real difference between the two structures, namely, said defendants' quick-action triple valve and the one shown in the patent in suit, is not an essential difference, and is wholly due to the specific form given to the parts.

279 X Q. You state that, in one form of defendants' quick-action triple valves, an opening could be made in the partition provided with restricting openings, which would necessarily have to be literally closed by the movements of the triple-valve piston, if the mechanism was to serve any useful purpose and be capable of serving the functions of a plain triple valve; what form of defendants' quick-action triple valves do you refer to here?

A. I refer to the form illustrated in plate IX of defendants' 1889 catalogue.

280 X Q. Please explain more particularly where, in that form of defendants' apparatus, you would make the opening to which you refer, and describe the opening which you would thus make?

A. I would remove a portion of the partition containing the restricted port or passage, which lies between the passage A (*b*) of said plate IX of defendants' 1889 catalogue, and the port closed by the "plug" valve 22 (15). The portion of said partition so removed, would be sufficient to make an opening of greater capacity than the openings *h h*, leading into the brake-cylinder from the port closed by said "plug" valve 22 (15). This would require such opening to be closed by the movements of said "plug valve" 22, the same as would be the case when the portion of the partition containing the restricted port or passage in the quick-action triple valve shown in the patent in suit, was removed as heretofore described by me.

281 X Q. Why do you restrict that hole to one form of defendants' apparatus, namely, the form shown in plate IX of the 350 1889 catalogue? If a similar hole were made at the same point, in the apparatus shown in plate XI of defendants' 1891 catalogue, would not all the results be substantially the same as with the hole made at the same point in the apparatus shown in plate IX of the 1889 catalogue?

A. I make no restriction whatever in the matter. I simply stated the fact in connection with the quick-action triple valve shown in plate IX of defendants' 1889 catalogue. That is, the fact that the same kind of an opening could be made in the quick-action triple valve shown in the 1889 catalogue that was made in the mechanism shown in the patent in suit, and with the same results.

As a matter of fact, a similar hole or opening, made at a corresponding point in the quick-action triple valve shown in the plate XI of defendants' 1891 catalogue, would render that apparatus entirely worthless for any useful purpose, and consequently the results would not be substantially the same, in the case of the quick-action triple valve shown in plate XI of defendants' 1891 catalogue, as

they would be with the quick-action triple valve shown in plate IX of defendants' 1889 catalogue. That is, in the case of the apparatus of the 1889 catalogue, such apparatus would serve all the functions of a plain triple valve, or a triple valve proper, while, in the case of the apparatus of the 1891 catalogue, this latter apparatus would be utterly worthless for any useful purpose whatever.

I mentioned this fact of making the opening in the quick-action triple valve shown in plate IX of defendants' 1889 catalogue, at the point between the passage A (b) and the port controlled by the valve 22 (15), simply to illustrate the fact that the specific form given to the parts, made the difference between the quick-action triple valve shown in the patent in suit, when provided with the opening as described by me, and said defendants' quick-action triple valve when the "bushing 9" was removed therefrom. Or, in other
351 words, that the difference between the said defendants' quick-action triple valves, with the bushing 9 removed, and the quick-action triple valve shown in the patent in suit, with the opening made as described by me, was a difference arising wholly out of minor specific details of construction, and not to any difference in the principle of operation of the several quick-action triple valves.

282 X Q. Why would the apparatus shown in plate IX of defendants' 1889 catalogue, and the apparatus shown in plate XI of defendants' 1891 catalogue, operate differently, in case that each had a hole such as you describe made from the passage A (b) to the port controlled by the plug valve 22 (15)?

A. The reason why the quick-action triple valves of the said two catalogues would act differently is, that in the quick-action triple valve shown in plate IX of defendants' 1889 catalogue, the opening, which I have described as being made, would be closed by the ordinary movement of the "plug" valve 22 (15), by the ordinary movements of the triple-valve piston when the brakes were "off," and also when a graduating or service-stop application of the brakes was to be made, while, in the quick-action triple valve shown in defendants' 1891 catalogue, such opening could never be closed by the ordinary movement of the valve 22 of said quick-action triple valve, and such opening would always remain open, and the brake-cylinder and auxiliary reservoir would always be in open communication, one with the other.

This open communication of the auxiliary reservoir and brake-cylinder, at all times, would prevent any storing of air or pressure in the auxiliary reservoir, because the auxiliary reservoir would be in open communication with the atmosphere through the brake-cylinder, and the apparatus would be wholly worthless for any useful purpose.

The closing of the corresponding opening in the quick-action triple valve shown in plate IX of defendants' 1889 catalogue, by the ordinary movements of the "plug" valve 22 (15), would
352 render such quick-action triple valve capable of performing all of the functions of a plain triple valve and such opening would only prevent such quick-action triple valve from performing

the quick-action function. In the case of the latter quick-action triple valve, the auxiliary reservoir and brake-cylinder would not always be in open communication, and would only be in open communication at the times necessary for a graduating or service-stop application of the brakes, and then only by the usual connections used for this purpose. Of course, I do not here include the attempt to make a quick-action or emergency application of the brakes, which, as before explained, would be defeated by reason of the opening leading from the auxiliary reservoir to the port controlled by the "plug" valve 22 (15)?

The drawing composing plate IX of said defendants' 1889 catalogue, is simply a cross-sectional view of the quick-action triple valve there shown, and the passage A (*b*) is shown as to only one of its dimensions, but I have assumed that the dimensions of said passage, in the direction not shown, are such as to correspond with the corresponding passage of plate XI of defendants' 1891 catalogue. Or, in other words, that the capacity of the passages is substantially the same.

283 X Q. As I understand you, then, the making of a hole, such as you describe, leading from the passage *b* to the seat of the valve 15, in defendants' apparatus shown in plate IX of defendants' 1889 catalogue, so that said hole would be closed and opened by said valve 15, would be, in all respects, the equivalent of the making of your imaginary hole, in the apparatus of the patent in suit, leading from the passage 46 to the seat of valve 14, and closed and opened by the movements of said valve 14; is my understanding correct?

A. It is, or, in other words, the making of the opening or hole, as described by me, leading from the passage A (*b*) to the port controlled by the "plug" valve 22 (15), is in all respects the
353 equivalent of removing the "bushing 9" of the quick-action triple valve shown in plate IX of defendants' 1889 catalogue.

284 X Q. The removal of the bushing 9, however, leaves a hole which is not controlled by a valve, whereas the making of the holes which you have imagined or assumed in the apparatus of the patent in suit, and the apparatus of the defendants' 1889 catalogue, produces a hole which does require to be opened and closed by a valve; am I not correct?

A. No, I do not think that you are, for in each case the hole or opening made has to be in effect controlled by a valve. For instance, take the quick-action triple valve shown in plate IX of defendants' 1889 catalogue; when the "bushing 9" is removed, the connection between the reservoir and brake-cylinder thus made has to be controlled, so far as the making of a graduating or service-stop application of the brakes is concerned, by the said "plug" valve 22 (15), and when the opening is made, between the passage A (*b*) and the port controlled by the "plug" valve 22 (15), it has to be likewise controlled by the same "plug" valve 22 (15), or, in other words, in each case the opening made between the auxiliary reservoir and the brake-cylinder has to be in effect controlled by a valve, so that such opening will be closed at the times heretofore stated,

viz., when the brakes are "off," and also when a graduating or service-stop application of the brakes is to be made, and, so far as the function of the opening made by a removal of a part of the partition containing the restricted port or passage is concerned, the result is identically the same in each case, and any difference in the way or manner of controlling such opening, whether it be by the removal of the bushing 9, or the removal of another part of said partition, as just described, is wholly owing to the removal of different parts of the same partition and not to any other fact.

In this connection, I would state that when the opening described by me is made between the said passage A (b) and the port controlled by the "plug" valve 22 (15), of plate IX of defendants' 1889 catalogue, it is wholly immaterial, so far as concerns any of the other operations of said mechanism, whether the "bushing 9" be left in place or be removed from such mechanism.

Adjourned to Monday, December 4, 1893, at 10.30 a. m.

NEW YORK, December 4, 1893—10.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Cross-examination of HENRY F. NEWBURY resumed:

285 X Q. If I understand you correctly, the valve 14, in conjunction with your imaginary hole, in the apparatus of the Westinghouse patent in suit, would perform the same functions as the valve 22, in conjunction with its port, in the apparatus of plate XI of defendants' 1891 catalogue. If such be the fact, the one arrangement or combination, (including the slide-valve 14 and its imaginary hole), is the equivalent of the other arrangement or combination, (including the valve 22 and its port): is this true?

A. Whether you understand me correctly or not, depends upon what you mean by the words "the same functions." If, by those words, it is to be understood that they refer only to the closing of the communication between the auxiliary reservoir and brake-cylinder, at the time or times when a quick-action or emergency application of the brakes is *not* to be made, and to this extent only, then your understanding would be substantially correct. If, on the other hand, the words "the same functions" are to have any other meaning than the one just stated, your understanding is not entirely correct.

355 It is true, to the extent above indicated, that the one arrangement or combination is the equivalent of the other arrangement or combination, that is, to the extent of closing communication between the auxiliary reservoir and the brake-cylinder, at the time or times when quick-action or emergency applications of the brakes are not to be made.

Of course, there may be other points of similarity between the two arrangements or combinations, that I do not think it necessary to refer to at this time.

286 X Q. For the purpose of making a service stop, or a graduated application of the brakes, the two arrangements referred to in my last question would be equivalents, would they? I assume, of course, that the bushing 9, of the Boyden apparatus, be removed.

A. This question, like the preceding one, depends wholly upon the understanding given to the language used, whether the answer shall be yes or no. That is, the language is broad enough to include points of equivalency which would require an answer one way, and then, with a more limited understanding of the term "equivalents," the answer would be directly opposite.

To the extent mentioned in my preceding answer, the two arrangements referred to would be equivalents, and substantially to that extent alone, and, with this understanding, I should answer yes.

On the other hand, if the language of the question is given its ordinary meaning, then the two arrangements would not be the equivalents one for the other, for the simple reason that the valves 14 and 22 perform entirely different functions, in the two combinations or arrangements, when a graduating application of the brakes is to be made. For instance, the valve 14 has to close communication between the brake-cylinder and the atmosphere, when a graduating application of the brakes is to be made, while the valve 22, on the other hand, cannot perform this function. Again, the valve

14 has to be still further moved, so as to open communication
356 between the auxiliary reservoir and the brake-cylinder, in order that a graduating application of the brakes be made, while, on the other hand, the valve 22 cannot be moved at such times, and, therefore, cannot perform this function which is performed by the valve 14.

Furthermore, if the graduating application of the brakes, referred to in the question, includes the release of the brakes, as it would naturally be assumed to include, then the valve 14 has to be moved so as to open communication between the brake-cylinder and open air, in order that a release of the brakes be made, and this is a function which the valve 22 cannot, by any possibility, perform.

From this it will be seen that, taking the two arrangements or combinations as a whole, without any more qualification than is made in the question, such two arrangements would not be the equivalents one for the other.

287 X Q. In your last answer you state that the valve 14 has to be still further moved, so as to open communication between the auxiliary reservoir and brake-cylinder, in order that a graduating application of the brakes be made; does such further movement of the valve 14, in and of itself alone, open communication between the auxiliary reservoir and the brake-cylinder, to make a graduating application of the brakes, or does such graduating application require not only that the valve 14 be so further moved, but also that the graduating valve 29 be moved independently of the valve 14, so as to open its port and establish communication between the auxiliary reservoir and the brake-cylinder? And is not the function of actually opening such communication performed by the

valve 29 instead of the valve 14, in the apparatus of the patent in suit?

A. At the time spoken of by me in my previous answer, all that is required for the admission of auxiliary reservoir pressure to the brake-cylinder, in the making of a graduating application of the brakes, is simply the further movement of the slide-valve 14, and there is no independent movement of the valve 29, relatively to the slide-valve 14, so far as the admission of auxiliary reservoir pressure to the brake-cylinder at this time is concerned.

So far as concerns the admission of auxiliary reservoir pressure to the brake-cylinder, the valve 29 has an independent movement relatively to the slide-valve 14, before the slide-valve can have any movement whatever to close communication between the brake-cylinder and the atmosphere, hence, at the time of admitting auxiliary reservoir pressure to the brake-cylinder, to make a graduating application of the brakes, it requires simply the further movement of the slide-valve 14. It is true that the graduating valve 29 is connected to the triple-valve piston, so that, whenever the triple-valve piston moves the slide-valve 14, the valve 29 must move in unison with the valve 14, and the only time that the valve 29 has an independent movement relatively to the slide-valve 14, is at such time as the valve 14 does not move with the triple-valve piston, but is stationary while the triple-valve piston moves.

It is also true that when a graduating application of the brakes is to be made, the valve 29 has an independent movement relative to the slide-valve 14, in order to shut off communication and stop the flow or admission of auxiliary reservoir pressure to the brake-cylinder. Or, in other words, so far as concerns the limiting of the amount of pressure which is to be admitted to the brake-cylinder from the auxiliary reservoir, when making a graduating application of the brakes, the valve 29 has an independent movement relatively to the valve 14.

From what I have just said, I think it will be apparent that the function of *actually* opening the communication between the auxiliary reservoir and the brake-cylinder, in making a graduating application of the brakes, is not performed by the valve 29 instead of the valve 14, in the mechanism shown in the patent in suit. Or,

in other words, that the valve 29, alone, cannot perform the function of actually opening such communication, and that it requires not only the movement of the valve 29, but also of the valve 14, in order that such communication shall be open, and, taken as a whole, neither one of these valves 14 and 29 can, alone, open communication between the auxiliary reservoir and the brake-cylinder, in making a graduating application of the brakes, and the movement of both valves is required.

Of course, when the valve 14 has once been moved into position to make a graduating application of the brakes, communication between the auxiliary reservoir and the brake-cylinder can be again opened and closed by the movement of the valve 29 alone, if it is desired that a second, third, or fourth admission of auxiliary reservoir pressure to the brake-cylinder be made, but it is to be remem-

bered that a graduating application of the brakes can be made without a second, third or fourth admission of auxiliary reservoir pressure to the brake-cylinder being made.

Notwithstanding the fact that a second, third, or fourth admission of auxiliary reservoir pressure to the brake-cylinder can be made without moving the valve 14, a graduating application of the brakes cannot be made without the movement of the valve 14 taking place, as described by me.

288 X Q. Still assuming the bushing 9 to be removed from the Boyden apparatus, and said apparatus, therefore, to be capable of use only for making a service-stop or graduating application of the brakes, do you regard its valve 22, and the stem containing the port 40, in said Boyden apparatus, as being the mechanical equivalent of the valve 14 and graduating valve 29, in the apparatus of the patent in suit, so far as concerns the function of admitting auxiliary reservoir air to the brake-cylinder, and closing such admission, in the application of the service stop or a graduation?

A. I understand the part of said defendants' apparatus to which counsel has applied the term "port 40," to be the portion of
359 the main valve 17-18 of plate XI of defendants' 1891 catalogue, which was marked by me in my former deposition as *i*, *k*, *j*, and which consists of the port *i*, passage *k*, and port *j* in the said main valve. It will depend somewhat upon the connection in which the words "mechanical equivalent" are to be used, whether I would consider the valve 22, and the portion of the main valve containing the ports *i*, *j* and the passage *k*, of said defendants' mechanism, the mechanical equivalent of the valve 14 and graduating valve 29, of the mechanism shown in the patent in suit.

In the broad sense in which the term "mechanical equivalent" is sometimes used, I should consider the valve 22 and the main valve 17-18, as the mechanical equivalent of the slide-valve 14 and valve 29. For instance, if I were considering the question of the combination of a plain triple valve with another mechanism, and the result to be attained by that combination did not depend upon the differences in construction or operation of the parts which made up the plain triple-valve portion of the combination, then, in such a case, I should consider the two as mechanical equivalents, or, as I think would be more correctly stated, that one would be a substitute for the other, in such a combination as indicated above.

As I understand said defendants' quick-action triple valves, and as I have seen the same tested, I do not regard the valve 22, and what counsel has termed "the stem containing the port 40," as the mechanical equivalent of the valve 14 and graduating valve 29, of the mechanism shown in the patent in suit, when making a service-stop or graduating application of the brakes.

So far as concerns the use of said defendants' quick-action triple valves, for making graduating and service stop applications of the brakes, the valve 22 might as well be a permanent part of the mechanism and wholly incapable of movement, while this is not the case with the valve 14 of the mechanism shown in the patent

in suit. Therefore, the valve 22, as a valve, has no function
 360 whatever to perform in said defendants' quick-action triple
 valves, in making a graduating or service-stop application
 of the brakes and would not be, strictly speaking, the mechanical
 equivalent of any portion of the valve 14 and graduating valve 29,
 of the mechanism shown in the patent in suit.

Of course, the valve 22, as before stated, would, under the cir-
 cumstances assumed in the question, perform the function of clos-
 ing communication between the auxiliary reservoir and the brake-
 cylinder, except through the usual connections required when
 making a graduating or service-stop application of the brakes, but
 this function I do not refer to, when saying "strictly speaking, the
 mechanical equivalent of any portion of the valve 14 and gradu-
 ating valve 29, of the mechanism shown in the patent in suit."

289 X Q. In the apparatus of the Westinghouse patent in suit,
 for the purpose of making service stops or graduating applications
 of the brakes, why was it necessary for Mr. Westinghouse to con-
 struct the apparatus so that not only the valve 29, but also the valve
 14, should be moved to effect the admission of auxiliary reservoir
 air to the brake-cylinder? And why could he not effect such ad-
 mission by constructing the apparatus so that a movement of valve
 29 alone would open communication between the auxiliary reser-
 voir and brake-cylinder.

A. The question assumes that it was necessary that the mechanism
 shown in the patent in suit be made in a particular way. So far as
 the question inquires about any such necessity, I must answer that
 I know nothing about it. That is, I know of no necessity which
 would require that the mechanism should be made in one way or
 another, so far as the graduating or service-stop application of the
 brakes is concerned. As I understand the matter, "the apparatus
 of the Westinghouse patent in suit" may be of any construction
 that the constructor sees fit to make it, in respect to the portion of
 such apparatus which has specially to do with the functions
 361 of a plain triple valve, that is, the functions required in
 making graduating and service-stop applications of the
 brakes.

The only reason that appears to my mind why the mechanism
 shown in the patent in suit is constructed so that not only the valve
 29, but also the valve 14, should be moved to effect the admission
 of auxiliary reservoir air to the brake-cylinder, is, that Mr. West-
 inghouse found it convenient to illustrate the invention of the patent
 in suit, in connection with a well-known form of plain triple valve,
 wherein the valve 14 and graduating valve 29 were both required
 to be moved, when making a graduating or service-stop application
 of the brakes.

290 X Q. Very well, I refer to that "well-known form" in my
 interrogatory, and I ask why it was necessary, in that form of plain
 triple valve, that not only the valve 29, but also the valve 14, should
 be moved to effect the admission of auxiliary reservoir air to the
 brake-cylinder, in the act of making a service-stop or a graduating
 application of the brakes?

A. The previous question simply referred to the patent in suit in these words: "In the apparatus of the Westinghouse patent in suit," &c., and made no reference specifically to the well-known form of plain triple valve known prior to the date of the invention of the quick-action automatic system of brakes by Mr. Westinghouse. The patent in suit particularly provides for the use of any kind of plain triple valve, no matter what its specific construction may be, in the combinations particularly recited in the claims thereof, so far as concerns the plain triple-valve functions, and I answered the question with that understanding.

The present question appears to be confined to only one of the several kinds of plain triple valves known at the date of invention of Mr. Westinghouse in the patent in suit. I must say that I do not know of any necessity which required Mr. Westinghouse, at the date of his application for the patent illustrating the construction referred to in the present question, to make the graduating valve 29, and also the valve 14, both move, when making a graduating application to effect the admission of auxiliary reservoir pressure to the brake-cylinder. Mr. Westinghouse might have illustrated his invention set forth in the patent which illustrates the well-known form of triple valve referred to in the question, otherwise than he did do, that is, he might have illustrated it with a different form of valve than the one shown in that patent. He found it convenient to illustrate that invention in connection with the particular kind of valve there shown, and, furthermore, this particular form of valve was one used by him in automatic systems of brakes, as I understand the matter.

This particular form of valve required to be moved, to close communication between the brake-cylinder and the atmosphere, as well as to be moved to open communication between such cylinder and the atmosphere. Furthermore, as this particular form of valve then existed, the triple-valve piston had a movement relatively to the valve, and it was a very convenient construction to adopt, in connection with the illustration of the invention found in such prior patent. The above are the only reasons, that I know of, why Mr. Westinghouse, in said prior patent, used the construction there shown, unless it be, that in addition to the above, the slide-valve with its so-called lost motion, was also an invention of his.

291 X Q. I did not ask why Mr. Westinghouse selected the form of plain triple valve which contained the graduating valve 29 and the slide-valve 14, as shown in his patent No. 360,070. He selected it, and, having selected it, he retained that feature of it which consists in its requiring a movement not only of the graduating valve 29, but of the main valve 14, in order to effect the admission of air from the auxiliary reservoir to the brake-cylinder, in the act of making a service-stop or a graduated application of the brakes. I

assume that he would have simplified the valve arrangement by dispensing with the necessity of moving the slide-valve

14 for such purpose, unless there was some necessity for its being so moved; and I ask you what such necessity was. Please

answer this question, if you know what the necessity was, without digressing into other matters.

A. I desire to state that I am not aware of digressing into other matters as stated in the question. The fact is, the questions are so indefinite that they may mean one thing or another, and therefore, I have to make explanations, and answer them, under the different meanings which they are capable of having put upon them.

The assumption of the present question seems to me unwarranted, when all the facts are considered.

As counsel now explains his question, it would seem to be substantially this. Mr. Westinghouse having adopted, for the purposes of illustrating the invention of the patent in suit, a triple valve proper, or plain triple valve, in which the main valve was of the sliding type, and which opened and closed communication between the brake-cylinder and the atmosphere, and also was provided with a graduating valve, which required that such graduating valve and main slide-valve both should have a movement, in order to effect the admission of air from the auxiliary reservoir to the brake-cylinder, in the act of making a service-stop or a graduating application of the brakes, what was the necessity for this requirement of the devices so selected. It would seem to me that after Mr. Westinghouse had once made the selection of devices having the above requirements that the necessity of the requirements was wholly due to the selection. At least, that is the only necessity that I can see for the requirement.

I must admit that the question to me is an exceedingly blind one, and that I cannot say I fully understand it, and if I have not stated what the question is intended to ask, I shall have to request counsel to make his meaning more clear.

364 292 X Q. You certainly have not answered my question, and, as you say you do not understand it, I will put it in other words.

In his patent No. 360,070, Mr. Westinghouse showed the triple valve proper of his prior patent No. 220,556. In that triple valve proper, there is a graduating valve seating in a slide-valve, and both must be moved in order to effect the admission of air from the auxiliary reservoir to the brake-cylinder, in making a service-stop or graduating application. There was evidently some reason for both of those valves being required to move for that purpose, or in that act; and I desire to know what the reason was.

A. I believe that I have answered the question fully, regarding the triple valve proper, or the plain triple valve, used to illustrate the invention of patent No. 220,556, but have no objection whatever to again answering it, but this seems to be an entirely different question from the one which preceded it, and which it purports to be the substance of.

Answering the question as to the specific construction of plain triple valves shown in patent 220,556, which construction differs somewhat from the construction shown in the patent in suit, I would say that the only reason of importance why the graduating valve, termed in said patent "auxiliary valve *e*", is made to move with

the main valve, designated in said patent as H, when making a service-stop or graduating application of the brakes, is that both are arranged to be moved by the triple-valve piston, and that they both have to be moved, in order to close and open communication between the brake-cylinder and the atmosphere.

Or, in other words, the slide-valve H has to be moved by the triple-valve piston, in order to open and close communication between the brake-cylinder and the atmosphere, and the connection of the so-called graduating or auxiliary valve *e*¹, to the triple-valve piston, necessarily requires that such auxiliary valve *e*¹, and slide-valve H, be moved, in order that a service-stop or graduating application of the brakes be made.

365 293 X Q. And the fact that the slide-valve 14 is charged with the function of opening and closing communication between the brake-cylinder and the atmosphere, is the thing that renders it necessary to give that slide-valve a movement, before admitting the auxiliary reservoir air to the brake-cylinder, to effect a service-stop or a graduated application of the brakes; is it not?

A. It is. Of course I refer to the specific form of valve shown in the patent in suit and designated as 14.

294 X Q. In the defendants' apparatus, as illustrated by plates IX (catalogue of 1889) and XI (catalogue of 1891), the valve 22 (15) is not charged with the function of opening and closing communication between the brake-cylinder and the atmosphere, is it?

A. The valve 22 (15) of said defendants' quick-action triple valves is not charged with any of the functions of a triple valve proper, including, of course, the function of opening and closing communication between the brake-cylinder and the atmosphere. Of course, I refer to the valve 22 (15) as a valve in this answer.

295 X Q. Question repeated, and the witness is requested to give a categorical answer to the question, without forcing in matters which might be a proper answer to some other question, but are not responsive to this one.

A. It is not.

296 X Q. Now, assuming the bushing 9, of defendants' said valve mechanisms, to be removed, and said mechanisms therefore to be capable of use only for service stops and graduation, state whether or not, for such service-stop and graduation purposes, the valve 22, the valve consisting of the stem which contains the port 40, and the valve 17 which controls communication between the brake-cylinder and the atmosphere, are, collectively, the mechanical equivalent of the main valve 14 and graduating valve 29, of the Westinghouse patent in suit?

366 A. The present question differs only from X Q. 288, in that it puts into the question, in terms, the portion of the main valve 17-18, designated 17 by me, in my former deposition, which I had to assume in my answer was present in that question, in order that a service-stop or graduating application of the brakes be made as stated in said X Q. 288.

My answer to the present question would be in substance the same as my answer to X Q. 288 was, which, briefly stated, is, in

substance, that under one understanding of the term "mechanical equivalent," that is, in certain combinations where substitute devices which, strictly speaking, are not the mechanical equivalent of the device of the combination, may be used, and yet serve the general purposes of the combination, the valve 22 and main valve 17-18 may be said to be, collectively, the mechanical equivalent of the valve 14, and graduating valve 29, of the mechanism shown in the Westinghouse patent in suit.

Under another understanding of the term "mechanical equivalent," that is, where each part must serve substantially the same function, in substantially the same way, the valve 22, and main valve 17-18, of said defendants' quick-action triple valves, would not be the mechanical equivalent, when taken collectively, for the valve 14 and graduating valve 29, of the mechanism shown in the Westinghouse patent in suit, because the valve 22, of said defendants' quick-action triple valve, does not find its functional equivalent in the valve 14 and graduating valve 29, of the mechanism shown in the patent in suit. That is, the valve 22, of said defendants' quick-action triple valves, does not, as a valve, serve any function whatever, in performing a graduating or service-stop application of the brakes, and at the most, can only be said that it serves the function of a permanent part of the mechanism at such time, and not the function of a valve which is required to be moved, when making a graduating or service-stop application of the brakes.

297 X Q. In defendants' said apparatus, the valve 17 is the mechanical equivalent of the valve 14 of the patent in suit, so far as concerns the opening and closing of communication between the brake-cylinder and the atmosphere; is it not?

A. It is. I believe I pointed out this fact in my former deposition.

298 X Q. The fact that the communication between the brake-cylinder and the atmosphere is opened and closed by the separate valve 17, in the defendants' apparatus, and is not controlled by valve 22, renders it unnecessary that the latter valve, 22, should be given any movement in effecting the admission of auxiliary reservoir air to the brake-cylinder in making a service-stop or graduation application; does it not? I mean, renders it unnecessary that there should be any provision or means for enabling the valve 22 to control the communication between the brake-cylinder and the atmosphere, by making a movement for that purpose.

A. The fact that the communication between the brake-cylinder and the atmosphere is opened and closed by the separate valve 17, in defendants' quick-action triple valves, has nothing whatever to do, as I understand the matter, with rendering it unnecessary that the valve 22 should be given movement when effecting the admission of auxiliary reservoir pressure to the brake-cylinder, in making a service-stop or graduating application of the brakes.

The real reason why it is not necessary to give movement to the valve 22, of said defendants' quick-action valves, when making a graduating or service-stop application of the brakes, is that such valve, as a valve, has no function to perform at such time or times.

Of course, it might be said, in a general way, that because the valve 22 has nothing whatever to do, as a valve, with the opening and closing of communication between the brake-cylinder and the atmosphere, that therefore it need not be moved or be provided with means for moving it, but this will be as true of any other part which had nothing to do with the making of a graduating or service-stop application of the brakes, as it is of the valve 22.

368 To illustrate my meaning I would say, that it being the fact that this desk, at which we are at work, has nothing to do with the making of a graduating or service-stop application of the brakes by defendants' quick-action triple valves, therefore it would not be necessary that the desk should be moved, or any provision be made for the moving of the same, when making a graduating or service-stop application of the brakes.

299 X Q. If a separate valve were not provided for the purpose of controlling the communication between the brake-cylinder and the atmosphere in the defendants' apparatus, the valve 22 would have to be provided with means for controlling that communication, or else the apparatus would be totally inoperative and useless, would it not?

A. No, it would not, as I understand the matter, but, on the contrary, would be as effective as it is now and, because of the fact that the valve 22, as a valve, has nothing whatever to do with performing the function of a triple valve proper, in said defendants' quick-action triple valves. So far as I am concerned, I must admit that I have used the term "separate valve," in connection with the opening and closing of communication between the brake-cylinder and the atmosphere, in said defendants' quick-action triple valves, somewhat loosely, for, strictly speaking, it is not true of the mechanism shown in plate XI of defendants' 1891 catalogue, any more than it would be true of the mechanism shown in the patent in suit.

In the mechanism illustrated in plate XI of defendants' 1891 catalogue, the part therein designated as 17, is as much a part of the portion designated as 18 therein, as are the corresponding parts of the valve 14, of the mechanism shown in the patent in suit. That is, in each case, they are connected together as one piece, so as to partake of each and every movement given to either one of them, and, in each case, they are provided with different ports or
369 passages which they control, so that their functions are the same.

300 X Q. In defendants' apparatus, if the valve 17 were not separate from the valve 22, the latter would have to be provided with means for controlling the communication between the brake-cylinder and the atmosphere, and given a movement for that purpose, or else the apparatus would be totally inoperative and useless, would it not?

A. I should expect that if any attempt was made to provide the valve 22, of said defendants' quick-action triple valves, with means for controlling communication between the brake-cylinder and the atmosphere, that said quick-action triple valves would be totally

inoperative and useless for the purposes of a triple valve proper, and therefore, I do not see how the fact that the portion of the main valve designated 17, and which closes communication between the brake-cylinder and the atmosphere, being separate from the valve 22, has anything to do with providing the valve 22 with means for opening and closing communication between the brake-cylinder and the atmosphere.

If the valve above designated as 17, in said defendants' quick-action triple valves, was attached to the valve 22, so that when one moved the other moved, then, of course, some other means would have to be provided for opening and closing communication between the brake-cylinder and the atmosphere, but I do not conceive of any means, at this time, which could be employed for this purpose, and have such means connected to the valve 22, so that a movement of the latter would be required to operate the former.

301 X Q. Of course, in the supposed case, it would be necessary to change the *form* of valve 22 and of its port. But suppose it was changed to the form of the slide-valve, for example, the form substantially as shown in the Westinghouse patent No. 220,556; then, in that case, it would be necessary to give the slide-valve a movement to enable it to close and open communication between
370 the brake-cylinder and the atmosphere, besides providing a graduating valve, to effect the admission of auxiliary reservoir air into the brake-cylinder, in making a service stop or a graduation. Am I right?

A. I cannot say whether you are or not, for the simple reason that the question does not give me any definite idea of the mechanism counsel has in mind.

If counsel will provide drawings and a description of his assumed structure, so that I may know just what it is, I shall then be pleased to attempt to make answer to the question; until then I cannot, for the reason given.

302 X Q. I will leave this subject for the present, to recur to it at a future time; and I will now proceed to other inquiries.

In the defendants' apparatus, the restricted passage and the bushing 9 are arranged between the piston chamber and the valve chamber, whereas, in the apparatus of the patent in suit, there is no restricted passage, or partition, or part of a partition, between the piston chamber and valve chamber; am I correct in this?

A. No, I do not think you are.

Adjourned to Tuesday, December 5, 1893, at 10.30 a. m.

NEW YORK, December 5, 1893—10.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Cross-examination of HENRY F. NEWBURY resumed:

303 X Q. Why am I not?

A. The reason why you are not correct, in my opinion, is the way you state the matter. If you had said the restricted passage, and

the bushing 9 forming a part of the partition, were arranged between the piston chamber and the valve chamber, whereas,
 371 in the mechanism shown in the patent in suit, the restricted passage was not arranged between the piston chamber and valve chamber, but that the piston chamber on the auxiliary reservoir side of the same was in open communication with the valve chamber, I should have said that you were correct. The restricted port I have reference to here, of course, is the restricted port which restricts or retards the flow of auxiliary reservoir pressure to the brake cylinder, at the time when the auxiliary reservoir and main air or train pipe pressure are to unite, when making a quick-action or emergency application of the brakes.

304 X Q. What substantial difference is there between my statements of the facts in X Q. 302 and your statement of them in your answer to X Q. 303?

A. The difference lies in the breadth of the statement, mine being a more limited one, and in strict accordance with the facts. Your statement might be understood this way, or it might be understood differently, and naturally I should expect it to be understood in such a way that it would be too broad to be in strict accordance with the facts.

There is a restricted passage between the piston chamber and the valve chamber, in said mechanism shown in the patent in suit, and there is a partition between the said piston chamber and valve chamber, in that mechanism, this partition being the piston itself and the restricted port, being the feeding-in port designated 51.

305 X Q. Do you really think that my X Q. 302 is capable of being construed to cover the triple-valve piston as a partition, and the feeding-in port 51 as a restricted passage, such as contemplated in my question?

A. I not only think it is capable of being so construed, but I also think it would be the ordinary construction put upon the question. A careful reading of the question shows that the wording of it is such that there is no direct reference made in the latter part
 372 of the question to the first part of it, and taking the question as a whole, I think it would be the natural understanding of it, to take it just as it says. It will be observed that, in reference to the defendants' quick-action triple valves, the question is limited to "the restricted passage and bushing 9," while, when referring to the mechanism shown in the patent in suit, the words "there is no restricted passage, or partition, or part of a partition," are used. From this it will be seen that the words were apparently used in their broadest sense, in the latter part of the question, and without any qualifying expression whatever as I should naturally expect to find, if it had been the intent of the person asking the question to have it given the limited construction which it would require to have, in order to be in strict accordance with the facts.

306 X Q. X Q. 302 inquired whether, in the apparatus of the patent in suit, there is a restricted passage, or partition, or part

of a partition, *between* the piston chamber and valve chamber. You say this might be construed as including the piston 12 and feeding-in passage 51. But the piston 12 and feeding-in passage 51 are *within* the piston chamber, and are not between the piston chamber and the valve chamber. Hence, I ask you again on what ground you would construe my X Q. 302 as including the piston and feeding-in passage, in view of the explicit terms used?

A. If counsel is familiar with the mechanism shown in the patent in suit, I think he will have to admit that the triple-valve piston 12 shuts off the piston chamber from the valve chamber when it is in the position shown in figure 2 of the drawings of the patent in suit, and that the only communication between the piston chamber and valve chamber is by the feeding-in port which includes the small recess made in the triple-valve piston. He must also be aware of the fact that the triple-valve piston is in open communication with the main air or train pipe, as much as such chamber

373 is in open communication with the auxiliary reservoir. Therefore, there has to be a partition between the triple-valve piston chamber and the valve chamber, unless some other meaning is to be given to the terms than I know of; for, without such a partition and restricted passage, the mechanism would be wholly inoperative. It is because of these facts that I have made the preceding answers in the forms in which they appear.

307 X Q. Did you really understand my X Q. 302 as in any way relating to the piston 12 and feeding-in passage 51?

A. I understood the question as I have heretofore stated, and gave it what I thought would be the natural understanding of it.

I can only know what the question means by what is placed upon the record, and if counsel desires to make his questions definite, why he can do so, but I cannot tell what understanding he has of the question in his mind, when he does not make such understanding clear on the record.

I answered each and every question as fully and fairly as I can, including X Q. 302.

I make this statement in view of the implied unwillingness or unfairness in the statement of this and preceding questions. In fact, the present question implies that I understood the question differently from what I have stated, and such is not the fact.

308 X Q. In making a quick action with the mechanism described and shown in the Westinghouse patent in suit, does not the air which enters the brake-cylinder from the auxiliary reservoir, pass through a port controlled by one valve, and does not the air which enters the brake-cylinder from the train-pipe pass through another and different port controlled by another and different valve?

A. It does, as I have time and again stated, when the mechanism shown in the patent in suit is employed.

309 X Q. In making a quick action by the defendants' 374 mechanism illustrated in plate IX (1889 catalogue) and plate XI (1891 catalogue), do not the air which enters the brake-cylinder from the auxiliary reservoir and the air which enters the

brake-cylinder from the train-pipe, both pass through one and the same port, controlled by one and the same valve?

A. If the question is limited to the time when the valve 22 opens its port, I should answer that they do pass through one port to enter the brake-cylinder, as I have time and again heretofore stated.

The auxiliary reservoir pressure passes through a port which is restricted as to its capacity, so that the flow of auxiliary reservoir pressure to the brake-cylinder is restricted or retarded, and none of the pressure from the main air or train pipe passing to the brake-cylinder, when making a quick-action or emergency application of the brakes, passes through this restricted port or passage. The fact is, that the auxiliary reservoir pressure, in both forms of defendants' quick-action triple valves, must necessarily pass through a port, through which main air or train pipe pressure cannot pass, when a quick-action or emergency application of the brakes is to be made, with either one of said defendants' quick-action triple valves.

The fact is, that the auxiliary reservoir and main air or train pipe pressures have united, and lost their individualities as main air or train pipe and auxiliary reservoir pressures, at the time they pass through the port or opening controlled by the valve 22, in said defendants' quick-action triple valves, and, at such time, it is wholly immaterial whether they pass through one opening alone to reach the brake-cylinder, or two ports, passages, or openings, as is evident from the fact that, in one form of said defendants' quick-action triple valves, namely, the one illustrated in plate XI of defendants' 1891 catalogue, these united pressures pass through a single port, opening, or passage to reach the brake-cylinder, while in the other form of said defendants' quick-action triple valve, the one shown in plate IX of defendants' 1889 catalogue, these united pressures

375 have to pass through two ports, openings, or passages, after passing the valve 22, before the brake-cylinder is reached. As I understand the matter, it is wholly immaterial how many ports or passages the auxiliary reservoir and main air or train pipe pressures pass through, after they have united to enter the brake-cylinder, but it is material and essential that the auxiliary reservoir pressure shall pass through a port or passage which restricts its flow, and through which main air or train pipe pressure cannot pass, and also that the two pressures, before they unite to pass into the brake-cylinder, must pass through two different ports or passages, in order that a quick-action or emergency application of the brakes can be made.

All that part of the above answer from and after the words "As I have time and again heretofore stated," is objected to by defendants' counsel, as a volunteered argument irresponsive to the question.

310 X Q. During the making of a quick action, with the mechanism described and shown in the Westinghouse patent in suit, does not the air which enters the brake-cylinder from the auxiliary reservoir, pass through the port or passage 35-22, controlled by the valve 14, while the air which enters the brake-cylinder from the

rain-pipe, passes through the port 42 controlled by the valve 41; and during the making of a quick action, with the defendants' mechanism shown in said plates IX and XI, do not the air which enters the brake-cylinder from the auxiliary reservoir, and the air which enters the brake-cylinder from the train-pipe, both pass through the one port controlled by valve 22? Please answer this question responsively, without argument, and without discussing other matters that are not inquired of.

A. I shall endeavor to answer the question responsively, but, nevertheless, I am under obligations to answer it truthfully; therefore, I must say that, as independent pressures, the auxiliary reservoir and main air or train pipe pressures do not pass through the port controlled by valve 22, in defendants' quick-action triple valves.

In the mechanism shown in the patent in suit, the auxiliary reservoir pressure, as an independent pressure, passes through the port or passage 35-22, 23, which port or passage is controlled or brought into register by the slide-valve 14, while the air from the main air or train pipe, as an independent pressure, passes through the port 42, chamber 43, and passage 46, to enter the brake-cylinder, the same as I have heretofore described.

311 X Q. In my last cross-question, 310, I said nothing about "independent" or non-independent pressures, but simply asked about the *air* which entered the brake-cylinder from the auxiliary reservoir and train-pipe, respectively; calling your attention to this fact, I repeat said interrogatory, and request you to give a direct and responsive answer to it, without attempting to force into it qualifications or limitations which do not exist in the question?

A. I desire to answer the question truthfully, and in fact must answer it that way or not at all, and, therefore, must state the facts as they exist and not by my answer misrepresent them. This I did in my preceding answer, and such answer, so far as I can see, is thoroughly responsive to the question. What counsel seems to term forcing into the question "qualifications or limitations which do not exist in the question" is nothing more, as I understand it, than simply stating the facts as they exist.

If he uses terms in the same question in one sense, in connection with one mechanism, and in another sense in connection with another mechanism, and without stating that he uses the same terms in a different sense, I cannot adopt the same terms, 377 when they mean different things, in connection with two pieces of mechanism.

The fact is, that after the auxiliary reservoir, and main air or train pipe, pressures have united to enter the brake-cylinder, at that time it is nothing more or less than brake-cylinder pressure, and not auxiliary reservoir and main air or train pipe pressures, although, of course, the brake-cylinder pressure is made up of main air or train pipe and auxiliary reservoir pressure.

We use the terms, main air or train pipe pressure, auxiliary reservoir pressure, and brake-cylinder pressure, simply to designate the same pressure in different parts of the apparatus.

From this it will be seen that, as a matter of fact, the two pressures, one from the auxiliary reservoir and the other from the main air or train pipe, after they have united to enter the brake-cylinder, are no longer correctly termed auxiliary reservoir and main air or train pipe pressures, and to insist upon so terming them is misleading and not in strict accordance with the facts.

It was because of the above that I answered X Q. 310 as I did, and I do not see how it could be truthfully answered any other way. With the above explanation, I will refer counsel to my above answer as an answer to the present question.

312 X Q. In X Q. 310 I said nothing about *pressure*, but spoke only of *air*. You have twice insisted upon placing a qualification upon my question, and then answering it as thus qualified by you. I now repeat the question again, and ask you to give a direct and responsive answer to it, without first attempting to qualify it, or alter its meaning.

A. I will have to ask counsel to state what he means by "air," as he seems to have used the term differently from what is understood in the air-brake art, as I understand the use of such term in such art.

313 X Q. As you do not understand what I mean by the word "air," I will endeavor to explain what I mean by it. I mean
378 that physical substance, of a gaseous form, composed of a mixture of oxygen and nitrogen, which substance moves from the auxiliary reservoir to the brake-cylinder, and also moves from the train-pipe to the brake-cylinder, in both the apparatus of the patent in suit and the apparatus of plates IX and XI of defendants' catalogues, in the act of making a quick application of the brakes. And in X Q. 310 I meant to ask you whether, in the making of a quick action, with the mechanism described and shown in the Westinghouse patent in suit, so much of that substance as enters the brake-cylinder, from the auxiliary reservoir, passes through the port or passage 35-22, controlled by the valve 14, while so much of that substance as enters the brake-cylinder, from the train-pipe, passes through the port 42 controlled by the valve 41; also whether, during the making of a quick action with the defendants' mechanism shown in plates IX and XI, do not so much of that substance as enters the brake-cylinder, from the auxiliary reservoir, and so much of that substance as enters the brake-cylinder, from the train-pipe, both pass through the one port controlled by the valve 22? If you now understand my question, please reply to it responsively and directly.

A. I do not fully understand now just what counsel means by "air" as he has explained it, as he has said nothing about the pressures of his air at the various times, by reason of which the several mechanisms are made to work, and, as I understand the term "air," as used in the fluid-pressure automatic brake mechanism, it is air under compression, and the terms "pressure" and "air," at the different times, are used as synonymous, meaning one and the same thing, and I believe this is the general understanding

of these terms, used in connection with the fluid-pressure brake mechanism.

It seems that counsel uses the term "air" in a different sense from what it is generally understood.

It would seem that my answer to X Q. 309 was a complete answer to the question, even in the sense in which counsel seems to have used the term "air," but it seems, for some reason, he has seen fit to pursue the inquiry, and, if his explanation means anything, it seems to me it must mean precisely what I stated it might mean, and, under that meaning, I fully answered the question in my answer to X Q. 309. It is true, as I there stated, that at the time when the valve 22 opens its port, the air from the auxiliary reservoir and the main air or train pipe, passes through that one port to enter the brake-cylinder, and this is the fact, and if that is the fact that counsel wants to elicit, I answered it then and again answer it now.

Likewise, at the time that the slide-valve 14 opens the port or passage 35-22, 23, so much of the "air" or "pressure" as enters the brake-cylinder from the auxiliary reservoir, passes through such port or passage, and at the same time, so much of the air or pressure which enters the brake-cylinder from the main air or train pipe, passes through the port or passage 42, 43 and 46, controlled by the valve 41, in the mechanism shown in the patent in suit, and these facts I have never disputed, and have heretofore pointed them out both in my former deposition and in the present one.

I make this explanation in view of the statements contained in his and preceding question, which imply that I do not fairly answer the question.

314 X Q. In the Westinghouse patent in suit, the passage 42, 43, 46, 47, 48, is the passage through which the train-pipe air is conducted to the brake-cylinder, in the act of making a quick-action application of the brakes. The passage 22 leads from the valve chamber 24 into the chamber 47, forming a portion of the passage 42, 43, 46, 47, 48, and thereby enables the auxiliary reservoir air, after it leaves the valve chamber, to unite with air coming from the train-pipe through said passage 42, 43, 46, 47, 48, in the act of making a quick application of the brakes. Was there any reason why the passage 22 should thus lead into the other passage, and why the passage 22 should not be connected to the brake-cylinder by a passage entirely separate from the passage 42, 43, 46, 47, 48, except in the matter of having, from the chamber 47 to the brake-cylinder, a single passage, instead of two separate passages? In other words, except for mere purposes of simplicity of construction, might not the air from the auxiliary reservoir have been delivered to the brake-cylinder, by a passage entirely separate from the passage which delivers the train-pipe air to the brake-cylinder, in making a quick application of the brakes, and would not such construction have answered every requirement of the Westinghouse invention in suit?

A. As I understand the question, it is substantially this: Is it essential or material to the invention of the Westinghouse patent

in suit, whether the main air or train pipe pressure and auxiliary reservoir pressure, actually unite before entering the brake-cylinder or not, so long as the respective pressures pass through properly proportioned ports or passages, so that they may unite in such cylinder, as set forth in the patent in suit.

With this understanding of the question, I should answer that I do not understand it to be material or essential, so far as the invention of the Westinghouse patent in suit is concerned, whether such two pressures actually unite before entering the brake-cylinder or after they have actually entered what would be technically known as the brake-cylinder. That is, whether they actually enter such cylinder through two passages or one. The essential thing, as I understand it, is that they should unite in the brake-cylinder, in properly regulated quantities.

315 X Q. If the valve 41 was removed from the apparatus of the patent in suit, and the port 42 plugged, what would be the effect on the action of said apparatus?

A. There would be no admission of main air or train pipe pressure directly to the brake-cylinder of the mechanism of the patent in suit, and this would be the case upon simply plugging the
381 port 42, and without the removal of the valve 41, as such plugging would render the valve 41 useless for any purpose that I call to mind at this time.

316 X Q. With said valve 41 removed and port 42 plugged, would the apparatus still operate as a plain triple valve?

A. Yes, it could be made to so operate.

317 X Q. Would it, without any further change in it, so operate?

A. Yes, it could be made to so operate without any change whatever.

318 X Q. What do you mean by your expression "could be made" to so operate?

A. I mean it could be made to so operate upon the proper manipulation of the engineers' valve or cock, and when the proper connections are made between the mechanism thus changed, and the main reservoir from which the fluid pressure is obtained.

319 X Q. The removal of the valve 41 and the plugging of the port 42, then, would have the same effect upon the action of the apparatus of the patent in suit, as the removal of the bushing 9 would have upon the action of the apparatus used by defendants and illustrated in plates IX and XI of their 1889 and 1891 catalogues, respectively; will it not?

A. There would be the same general effect produced in each case, that is, the prevention of a quick-action or emergency application of the brakes.

320 X Q. And without preventing the use of the two mechanisms, respectively, for the purposes of making service stops and graduating applications of the brakes; is that true?

A. Yes, that would be included within the said general result.

321 X Q. Would such removal of the valve 41 and plugging of the port 42 remove any portion of the "partition," which, in your
248 X A., you say you find in the quick-action triple valve shown

in the patent in suit, and which, in your 249 X A. you say "consists of the metal which divides the auxiliary reservoir, valve chamber 24, and triple-valve piston chamber 11, on the one hand, and the brake-cylinder upon the other, including, of course, the metal composing the slide-valve 14, with its restricted port or passage 35"?

A. As I understand the partition and its restricted port, in the mechanism shown in the patent in suit, the plugging of the port 42 and the removal of the valve 41 would not necessarily remove any portion of such partition.

322 X Q. Assume the apparatus shown in the patent in suit to have the valve 41 removed and the port 42 plugged, and to be used on a train, with the necessary connections, main reservoir, engineers' valve, train-pipe, auxiliary reservoir, brake-cylinder, etc., as used in actual practice; and assume that by accident the train-pipe became ruptured or broken in two so as to suddenly reduce the pressure therein, and apply the brakes automatically; and please describe the movement of the triple valve, and of the air passing through it that would then occur in such automatic application of the brakes? In other words, tell us just how the apparatus would act in making such automatic application?

A. Upon the rupture of the main air or train pipe and the sudden reduction of pressure therein, the triple-valve piston would be forced backward as far as it could move, and, at the beginning of this backward movement, the valve 29 would become unseated, and then the valve 14 would be moved in the direction of the movement of the triple-valve piston, until the port 31 was in register with the port 23, 22, and the port 33 was brought out of register with ports 23 and 34, thus shutting off communication between the brake-cylinder and the atmosphere, and opening communication between the auxiliary reservoir and the brake-cylinder. The communication between the auxiliary reservoir and the brake-cylinder, through the port 31, 23, is momentary, owing to the fact that the valve 14 and triple-valve piston would continue their movement to the limit of the backward movement of such piston.

383 At this time, the port 35 would be in register with the port 23, so that communication between the auxiliary reservoir and the brake-cylinder would be open, and this communication would remain open, until the pressures in the brake-cylinder and auxiliary reservoir became substantially equalized, or the same as to extent.

Such a rupture of the main air or train pipe would allow of all the pressure therein to escape and consequently the brakes would be held on, by the equalized pressure of the auxiliary reservoir and brake-cylinder, until such time as they should be released, either by leakage, the removal of pressure from the brake-cylinder and the auxiliary reservoir, or the mending of the rupture and again establishing the main air or train pipe pressure.

323 X Q. Assume the same apparatus and the same conditions stated in my last question, with the further condition that the passage 35 were plugged; and state just how the apparatus would

act upon the sudden reduction of pressure in the ruptured train-pipe, and what would result?

A. The movements of the parts would be identically the same, under the assumption of the present question, as they were under the assumption of the preceding one, but, owing to the fact that the port 35 was plugged or, in other words, did not exist, then of course, the brakes would only be applied with the force which entered the brake-cylinder at the time that the port 31 momentarily registered with the port 23, upon the backward movement of the triple-valve piston, and, therefore, the pressure in the auxiliary reservoir and brake-cylinder would not be substantially equal, or of the same extent, under the assumptions of the question, as would be the case under the assumptions of the previous question.

324 X Q. Assuming the same apparatus and all the conditions stated in X Q. 323, and assume that the auxiliary reservoir pressure were standing at its normal seventy pounds at the time when such rupture of the train-pipe occurred; and tell me, as 384 nearly as you can estimate, how much air pressure would be established in the brake-cylinder, by the air which flowed into it during the momentary passage of port 31 over port 23, as you have stated?

A. I cannot state how much pressure there would be in the brake-cylinder at the time stated, for the simple reason that there are so many things which enter into the problem, that it would be almost impossible to make an estimate, and I never have made any experiments which would demonstrate the amount of pressure which would ordinarily exist under the conditions named.

325 X Q. The amount of pressure so established in the brake-cylinder would be very small, would it not?

A. I should expect that it would be.

326 X Q. Do you think that it would be as much as five pounds to the square inch in the brake-cylinder?

A. That I cannot say, but I am under the impression that it would be less than five pounds, although this is merely a wild guess, without any reliable data to base the opinion upon.

327 X Q. As the Westinghouse air brakes are constructed and used, how much air pressure is required in the brake-cylinder to overcome the resistance of the spring against the piston of the brake-cylinder and move said piston?

A. I never have examined as to this point when making tests and, therefore, cannot say what the necessary pressure is to overcome the springs which are used to force the brake-shoes away from the wheels.

328 X Q. The spring that is used to force the brake-shoes away from the wheels is the spring marked 53, in figure 7 of the patent in suit, is it not?

A. Yes.

229 X Q. Assume the apparatus used by the defendants, and shown in plates IX and XI of their 1889 and 1891 catalogues, respectively, but with the bushing 9 removed; assume such apparatus to be used on a train with all the necessary connections referred to

in X Q. 322; then assume that by accident the train-pipe became ruptured or broken in two, so as to suddenly reduce the pressure therein and apply the brakes automatically; and please tell us just how the apparatus would act in making such automatic application.

A. The rupture of the main air or train pipe and sudden reduction of pressure therein, would cause the triple-valve piston to move backward, and, as it moved backward, the portion of the main valve designated by me as 17, would close communication between the brake-cylinder and the atmosphere, and then the other portion of the main valve, containing ports *i, j* and passage *k*, would be moved sufficiently to open communication between the auxiliary reservoir and the brake-cylinder momentarily, while the triple-valve piston was moving the main valve sufficiently for the collar *m*, of the mechanism illustrated in plate XI of defendants' 1891 catalogue, to come in contact with the auxiliary valve 22, and move such valve so as to open communication between the auxiliary reservoir and the brake-cylinder to a much greater extent than when such communication was through the main valve alone, which would cause the pressure in the auxiliary reservoir to almost instantly equalize with the pressure in the brake-cylinder and thus apply the brakes automatically. The equalization of the pressures in the auxiliary reservoir and the brake-cylinder occurs almost instantly, owing to the large opening made between the two by the movement of the auxiliary valve 22, when the triple-valve piston moves to the extent of its backward movement.

A rupture of the main air or train pipe which would suddenly reduce the pressure therein, would permit of the entire escape of the main air or train pipe pressure, and consequently, the brakes would be held on by the equalized pressures in the brake-cylinder and auxiliary reservoir, until the pressure in the brake-cylinder was released by leakage, opening communication between the auxiliary reservoir and the atmosphere, or the mending of the rupture in the main air or train pipe, and re-establishing main air or train pipe pressure therein.

330 X Q. The apparatus of the patent in suit, under the conditions assumed in X Q. 322, and the defendants' apparatus, under the conditions assumed in X Q. 329, would act substantially the same, except that the equalization of pressure between the auxiliary reservoir and the brake-cylinder would take place more quickly in the defendants' apparatus than in the apparatus of the patent in suit; am I not correct?

A. You are substantially correct.

331 X Q. If, instead of the form of triple valve shown in the patent in suit, the form of triple valve shown in the Westinghouse patent No. 220,556 were substituted, then, under the conditions stated in X Q. 322, the Westinghouse apparatus would act substantially the same as the defendants' apparatus would act under the conditions stated in X Q. 329, except that the equalization of air pressure between the auxiliary reservoir and the brake-cylinder, in the Westinghouse apparatus, would take place more quickly

than when the triple valve used was constructed in the form shown in the patent in suit; am I not correct?

A. I hardly know what the question is intended to mean. As it appears to me, it simply asks what the action of the triple valve shown in patent 220,556 would be, when used in the ordinary manner, and upon an accident occurring which would rupture the main air or train pipe, and thereby suddenly reduce the pressure in such pipe. If the question is intended to ask any more than this I would like counsel to so state and explain the question further before proceeding to answer it.

332 X Q. You may answer the question upon the assumption stated in your last answer, as that will enable us to get at the facts referred to in my question.

A. The triple valve shown in patent 220,556, when used in the ordinary manner and upon the occurrence of an accident which would rupture the main air or train pipe and suddenly reduce the pressure therein, would act as follows: The sudden
387 reduction of pressure in the main air or train pipe would cause the triple-valve piston to move backward, first unseating the valve designated as auxiliary valve e^1 in said patent, then moving the slide-valve H so as to close communication between the brake-cylinder and the atmosphere, then momentarily opening communication between the brake-cylinder and the auxiliary reservoir, through the port s^2 in the valve H, while such port is in register with the port C, leading to the brake-cylinder, and then closing such communication, and opening it again when the port s^1 of the valve H is in register with said port C. This last communication is also momentary and lasts while the port s^1 is in register with said port C. The continued movement of the triple-valve piston and the valve H, again opens communication between the auxiliary reservoir and the brake-cylinder, when the valve H has passed beyond or from over any portion of the said port C. This latter occurs when the triple-valve piston is at the extreme limit of its backward stroke, or nearly so, and it permits the auxiliary reservoir pressure to expand into the brake-cylinder and the two pressures to substantially equalize and thus apply the brakes.

A rupture of the main air or brake pipe which would thus suddenly reduce the pressure therein, would permit all of the main air or train pipe pressure to escape, and, consequently, the brakes would be held on by the equalized pressures in the auxiliary reservoir and brake-cylinder until such pressures were released by leakage, the removal therefrom by opening communication between the auxiliary reservoir and the atmosphere, or, upon the mending of the rupture in the main air or train pipe, and re-establishing main air or train pipe pressure therein.

333 X Q. The action of the Westinghouse apparatus of the patent in suit under the conditions stated in X Q. 322; the action of the defendants' apparatus under the conditions stated in X Q. 329; and the action of the apparatus of the Westinghouse patent
388 220,566 under the conditions stated in X Q's 331 and 332; would be substantially the same, except that, with the de-

fendants' apparatus, the equalization of pressure between the auxiliary reservoir and the brake-cylinder would take place quicker than with the apparatus of either of the two Westinghouse patents, and said equalization would take place quicker with the apparatus of patent 220,556 than with the apparatus of patent 360,070; am I correct in this?

A. The actions of the several mechanisms would differ in other respects than those stated by counsel, but, notwithstanding this, the general effect of simply applying the brakes automatically by an equalization of pressure in the auxiliary reservoir and brake-cylinders of the several mechanisms, would be substantially the same, except as to the particulars named in the question. That is, the same general result, namely, applying the brakes automatically by the equalized pressures of the auxiliary reservoirs and brake-cylinders, in the several mechanisms, is substantially the same, except as to the particulars named in the question.

334 X Q. The automatic application of the brakes, in case of the rupture of the train-pipe, is one of the important and advantageous features of the Westinghouse automatic air-brake system, so called; is it not?

A. It is.

335 X Q. When and in what patent did Mr. Westinghouse first introduce that important and valuable feature of air-brake mechanism.

A. I never have looked up the state of the art to determine in just what patent that feature appeared, but I believe it appeared in a Westinghouse patent which was issued early in the year 1872. It is a good while since I have read over the early Westinghouse patents, therefore I cannot at this time state which one was the first to show it.

336 X Q. It appeared in Westinghouse patent No. 168,369, 389 dated October 5, 1875, and had already at that time been made known in some prior patent of Mr. Westinghouse—am I not correct?

A. I believe that you are.

Adjourned to Wednesday, December 6, 1893, at 10.30 a. m.

NEW YORK, *December 6, 1893*—10.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Cross-examination of HENRY F. NEWBURY resumed:

337 X Q. In your answer to X Q. 210, you speak of certain tests made by you, and I judge from the passages commencing with the words "by actual tests" and "furthermore I have made repeated tests" that you made at least two series or sets of tests with different mechanisms, both of which series are referred to in that answer; am I correct about that?

A. Yes, there are two series of tests, and with different quick-action triple valves referred to in that answer.

338 X Q. Please describe the tests first mentioned in that answer, stating the circumstances under which they took place, who was present, and where they took place.

A. I described the construction of the quick-action triple valve used in that test, in my answer referred to in the previous question, and also the results. The circumstances under which the said tests were made are substantially these. I desired to inform myself as to the action of quick-action triple valves, in some respects like those shown in plate XI of defendants' 1891 catalogue, so I requested the Westinghouse Air Brake Company to reproduce, as near as they could do, a quick-action triple valve like that shown in plate
390 XI of defendants' 1891 catalogue, except that there should not be a valve 22, and that there should be substituted in place thereof a permanent partition, as described by me, and that, if it was possible, such reproduction should be from a quick-action triple valve of defendants' construction which they had.

Some time afterward, I was informed by counsel in the case, that the quick-action triple valve had been reproduced, and was ready for test whenever the time could be arranged. A time was arranged for such test, and I visited Pittsburgh, where I met Mr. Bell, of counsel herein, and we went to the factory of the Westinghouse Air Brake Company, at Wilmerding, Pennsylvania, where the test took place. Mr. Bell, of counsel, was present and I believe a Mr. Welsh, superintendent of the works, with some of the workmen, were also present.

I cannot say positively at this time, but I am under the impression that Mr. H. H. Westinghouse was also present at these tests.

I am not positive on this point, owing to the fact that first and last, in connection with various matters, I have made quite a large number of tests, at some of which Mr. Westinghouse was present, and others where he was absent, and I do not recall, at this moment, any particular circumstance which would enable me to state that he was present at these particular tests.

339 X Q. Describe exactly the conditions under which those tests referred to in your last answer were made—I mean the conditions as to the connections, the engineers' valve, and whether the tests were made with a single triple valve alone, or whether they were made in connection with other triple valves?

A. I cannot at this time give the exact conditions under which the tests took place, but I will describe them as nearly as is possible at this time.

The tests were made on the testing bench used by the Westinghouse Air Brake Company to make tests of triple valves, and represented, as nearly as possible, the conditions present upon
391 trains and regular service. That is, there was a regular main reservoir, which was supplied with pressure from an air pump, a regular engineers' valve, and a main air or train pipe, connecting the main reservoir and engineers' valve with the triple valves, having the dimensions and length usual in actual use. Some of the tests were made with the single quick-action triple valve which the Westinghouse Company had reproduced, as before described, and

other tests were made with such single triple valve coupled, up in the usual manner, with a quick-action triple valve the same as plate XI of defendants' 1891 catalogue, a new Westinghouse quick-action triple valve, and a plain triple valve, representing the equipment of four cars and a locomotive, of course, excluding the tender.

In each case there was a brake-cylinder and an auxiliary reservoir, the pistons of the brake-cylinders not being actually connected to anything which would represent the connections between brake-shoes and such pistons.

Each auxiliary reservoir, brake-cylinder, and main air or brake pipe was provided with a pressure gauge, to register the pressures present in each of such cylinders, auxiliary reservoirs, and the main air or brake pipe. The pressure gauges attached to the main air or brake pipe were placed in the immediate vicinity of the main air or train pipe side of the triple-valve piston. In addition to the above pressure gauges, there was placed on each of the quick-action triple valves representing the mechanism of plate XI of defendants' 1891 catalogue, a pressure gauge, in connection with the valve chamber of each of those mechanisms, so that the pressure in such valve chamber could also be ascertained at different periods of time.

Tests were also made with the quick-action triple valve having a permanent partition substituted for the valve 22, when the regular defendants' quick-action triple valve was cut out, so that there were only three triple valves connected up. Tests were also made when

392 another reproduction of the quick-action triple valve illustrated in plate XI of defendants' 1891 catalogue was substituted for the regular defendants' quick-action triple valve.

Tests were made for graduating, service-stop, and quick-action or emergency applications of the brakes. Tests were also made by manipulating the engineers' valve in different ways, when making graduating and service-stop applications of the brakes.

340 X Q. In your last answer you say that "tests were also made when another reproduction of the quick-action triple valve illustrated in plate XI of defendants' 1891 catalogue was substituted for the regular defendants' quick-action triple valve;" do you mean that the other reproduction was in any way different from the regular defendants' quick-action triple valve?

A. It was intended to be the same, but we desired to make tests in different ways which would require some mutilation of the casing of the triple valve, so that we could not use the regular defendants' quick-action triple valve, because it was desired to use that as an exhibit in this case.

341 X Q. By "the regular defendants' quick-action triple valve" do you mean the one in which the fixed partition had been substituted for the valve 22?

A. No; I do not, as I think will be apparent from my former answers.

342 X Q. Now, will you please describe all the particulars and conditions of the second series of tests mentioned in your answer

to Q. 210, commencing at the words "furthermore I have made repeated tests"?

A. The second series of tests referred to were also made at the factory of the Westinghouse Air Brake Company, and there was only a single quick-action triple valve used in those tests, the construction of which I substantially described in my direct examination. This quick-action triple valve was, as I understand the matter, of defendants' manufacture, and, as before stated, was provided with glass windows in the valve chamber, so that the operation of the valve could be readily observed.

393 These tests were made under various conditions, using the same main reservoir, but using different piping from that heretofore described. Some of the tests were made with the length of pipe leading to and from the triple valve of substantially the length used in actual service, and, at other times, varying the length of pipe to see if it made any difference; also some of these tests were made with an engineers' valve or cock so arranged that we could have different-sized openings for the escape of main air or train pipe pressure, when reducing the pressure in the main air or brake pipe to operate the triple-valve piston.

These tests were made at my solicitation, so that I might further study the operation of defendants' quick-action triple valve, and see whether the conclusions I arrived at prior to the last-named test would be confirmed or not, as well as to see whether my understanding of the theory of the operation of said defendants' quick-action triple valve under varying conditions were correct or not.

Other tests than those referred to in Q. 210 were made with this quick-action triple valve provided with the glass window, as before described.

At this second series of tests, Mr. Bell, of counsel herein, Mr. H. H. Westinghouse, and some of the employees of the Westinghouse Air Brake Company were present.

343 X Q. In your answer to Q. 219 you refer to several series of tests; will you please describe all the conditions and particulars of those different tests?

A. I have already done so. The tests referred to in my answer to Q. 219 are tests which refer to the operation of defendants' quick-action triple valve, when coupled up with the new Westinghouse quick-action triple valve, which tests I have this morning described.

344 X Q. In your answer to Q. 232, and elsewhere in your deposition, you refer to the "principle or mode of operation" of the patented device of the patent in suit and of the defendants' device; please state exactly the meaning that you attach to that expression, "principle or mode of operation," and the sense in which you have used the term in your deposition.

A. I have used the term "principle or mode of operation" as referring to the law of operation of such mechanisms, or rather, the underlying principles upon which those mechanisms work, so far as quick-action or emergency applications of the brakes are concerned.

315 X Q. Please illustrate your meaning by stating, as briefly as you can, the "principle or mode of operation," or the "law of operation," of the quick-action triple-valve device or mechanism of patent No. 360,070, in the sense in which you use those expressions.

A. The patent in suit, No. 360,070, describes a combination of devices by means of which three classes of work, as before described by me, are rendered capable of being performed by such combination or combinations of devices or elements. The patent in suit describes the construction and arrangement of these several elements or devices which go to make up the combination or combinations set forth in said patent, and states the results accomplished by such combination or combinations, and gives the necessary instructions for the construction of the elements or devices, and combining them together to perform such results.

These several elements or devices depend upon certain conditions being present, in order that they perform their respective parts in such combination or combinations. The patent in suit describes the mode of operation, and the action, of each of the respective devices or elements which go to make up the combination or combinations set forth in said patent.

The operation of the combination or combinations set forth in the patent in suit, as therein described, depends upon well-known principles or laws, governing the action of gaseous fluids when under compression, which laws or principles of action are well known. I refer here more especially to the actions of such fluids,

when under compression, upon movable parts, which such
395 fluids are to move by varying the degrees of compressions of the fluids at different times, as well as the passage of such fluids, when under compression, through ports or passages from one point to another, and the actions of such ports or passages have upon the degrees of compression of such fluids, after their passage through such ports or passages.

The principle or mode of operation of the mechanism set forth in the patent in suit, so far as concerns a quick-action or emergency application of the brakes, is as follows: Upon a sudden and material reduction of main air or train pipe pressure (say 15 to 20 pounds), the triple-valve piston will be moved backward to a further extent than ordinarily is the case, which backward movement opens an auxiliary valve, controlling a passage of considerable size, leading from the main air or train pipe to the brake-cylinder, and, at the same time, opens another passage, of comparatively small diameter, leading from the auxiliary reservoir to the brake-cylinder, both passages being open to the brake-cylinder at a time when such cylinder is comparatively free from pressure, so that the amount of compressed air or fluid pressure which can pass through each of the two passages in a given length of time is regulated or governed, to such an extent that the lower main air or train pipe pressure, (say 50 to 55 or more pounds), is permitted to enter the brake-cylinder in large volume, while the higher auxiliary reservoir pressure, (say about 70 pounds), is also passing into the brake-cylinder in small volume, the two pressures uniting at a point within the brake-cyl-

inder, which is in wide-open communication therewith, and brake-cylinder pressure is formed by such uniting of the main air or train pipe and auxiliary-reservoir pressure. The brake-cylinder pressure thus formed, is the pressure which acts upon the brake-cylinder piston to apply the brakes, and, when making a quick-action or emergency application of the brakes, is of a considerably higher pressure than when an application of the brakes is made by the equalization of pressure between the auxiliary reservoir and
 396 brake-cylinder alone, and, under the above assumed conditions as to the amount of pressures, such united brake-cylinder pressure would be about 60 pounds, when the proportions of the several parts of the mechanisms are substantially the same as those in actual use.

Briefly stated, some of the essential requisites of the principle or mode of operation of the mechanism shown in the patent in suit are, when a quick-action or emergency application of the brakes is to be made, that the brake-cylinder shall be substantially free from pressure, that the point at which the main air or train pipe and auxiliary-reservoir pressures unite shall be in substantially wide-open communication with the brake-cylinder, that the passage leading from the main air or train pipe to the brake-cylinder, and controlled by the auxiliary valve, shall be of considerable size, and that the passage or port between the auxiliary reservoir and the brake-cylinder, at this time, shall be of comparatively small diameter, so that the flow of auxiliary-reservoir pressure to the brake-cylinder at this time is restricted, retarded, or small in quantity.

346 X Q. In the ordinary application of the Westinghouse quick-action air brake for an emergency stop, how much higher pressure is obtained in the brake-cylinder than with the action of the plain triple valve?—assuming, in both cases, that the application is made with full force, so that the pressure in the brake-cylinder becomes equalized with the pressure in the auxiliary reservoir?

A. As before stated, the brake-cylinder pressure, when making a quick-action or emergency application, with the Westinghouse quick-action triple valve, is about 60 pounds, when main air or train pipe pressure before the sudden reduction is 70 pounds, while, with the same apparatus, in making a service-stop application, the brake-cylinder pressure is about 50 pounds, with a train-pipe pressure at 70 pounds, as before stated.

This is also the case with the Westinghouse plain triple valve, if

I remember correctly, although, at this time, I cannot give
 397 the exact figures obtained at the tests heretofore described, as they took place some considerable time since.

Of course, in each case, this is when the pressures in the auxiliary reservoir and brake-cylinders have equalized, and applied the brakes with the full force possible.

347 X Q. How many valve-controlled ports, passages, or channels, for the traverse of air under pressure from the auxiliary reservoir to the brake-cylinder, were actually used in a valvular appliance known prior to 1887, in operating it as a triple valve?

A. That would depend wholly upon what particular valvular appliance is used.

348 X Q. Assume that the valvular appliance described and shown in the Westinghouse patent No. 220,556 was used, and answer the question.

A. I should say that, in the plain triple valve shown in patent 220,556, there were three valve-controlled ports, passages, or channels for the traverse of air under pressure from the auxiliary reservoir to the brake-cylinder.

349 X Q. What three?

A. The two in the slide-valve II designated as s^1 , s^2 , and the third by the uncovering of the passage C by the movement of the valve II either partly or wholly beyond such passage.

350 X Q. In that apparatus, the passage s^2 is simply for leakage purposes, is it not?

A. The port or passage s^2 is, I believe, primarily provided for removing pressure from the auxiliary reservoir by leakage, but, nevertheless, as I understand it, pressure does not enter the brake-cylinder through such port or passage in the application of the brakes, but, as before explained, this can only be to a limited extent, owing to the momentary time that the said passage is in register with the port C.

I also believe that some pressure might leave the auxiliary reservoir through this port, at this time, which did not enter the brake-cylinder, but, notwithstanding this fact, I also understand that auxiliary reservoir pressure at this time also enters the brake-cylinder.

351 X Q. The amount of auxiliary reservoir pressure entering the brake-cylinder during the passage of the port s^2 over the port C would be practically inappreciable, would it not?

A. That would depend upon circumstances. The port s^2 , in the operation of the brakes, might admit almost as much pressure to the brake-cylinder as the port s^1 admits.

This would depend wholly upon circumstances contingent upon the operation of the mechanism.

352 X Q. What circumstances?

A. For instance, the extent of reduction of main air or train pipe pressure; also, the extent of friction of the slide-valve II, as well as the friction of other parts of the mechanism, when making a graduating application of the brakes.

353 X Q. In the ordinary application of the brakes for a service or graduation, with the apparatus shown in patent 220,556, would not the amount of pressure admitted from the auxiliary reservoir to the brake-cylinder, through the port s^2 , be practically inappreciable?

A. I do not see but what it might be practically inappreciable, or practically appreciable, according to circumstances beyond the control of the person making what he supposes to be an ordinary graduating application of the brakes.

To further explain my meaning, assuming a train of cars, four or five in number, fitted with plain triple valves like those illustrated

in patent 220,556, and the engineer desirous of making a graduating application of the brakes to hold his train in check, he would make a small reduction of pressure in his main air or train pipe, and if, in one or more of the triple valves, there was more friction of the slide-valve than in the other, the reduction in pressure would not move the slide-valve H as far, in such valve or valves, as it would in the other, from which it would result that, in the

399 case of the slide-valve having the greatest friction, the port s^2 would be left in register with the port C, and also at the same time a portion of the port s^1 would be in register with the same port C, while, with the triple valves provided with slide-valve H having less friction, such valves H would be moved a trifle farther, so as to move the port s^2 out of register with the port or passage C, so that practically all of the pressure entering the brake-cylinder, through the last-named valve, would pass through the port s^1 , which would not be the case with the triple valve or valves in which the slide-valve H had the most friction. The difference in the movement of the slide-valves in the two cases is only slight, and the result, as to the amount of pressure entering the brake-cylinder from the auxiliary reservoir, would be the same whether it all passed through the port s^1 , or part of it through that port, and the rest through port s^2 , the only difference being that, when the pressure passed wholly through the one port, it would enter the brake-cylinder a trifle quicker than would be the case when such pressure passed partly through one and partly through the other.

254 X Q. Do you understand that it was the intention of Mr. Westinghouse, the patentee, to utilize the port s^2 for transmitting auxiliary reservoir pressure to the brake-cylinder, in the act of making a service stop or a graduating application of the brakes?

A. I have already stated what I understood was primarily the purpose of the port or passage s^2 , and such understanding I obtain from the specification of patent 220,556.

If we can judge of the intentions of Mr Westinghouse by the mechanism which he produced, I should say that it was his intention, under the circumstances stated by me, to have that mechanism operate as I have stated, for I cannot for a moment think that he did not fully know what the operation of the mechanism would be, under varying conditions.

What we have been pleased to term service-stop applications of the brakes, can be performed in different ways, by the mechanism shown in the patent 220,556; therefore, as to that branch of the question which couples service-stop application of the brakes with graduating application, I should answer that by the same reasoning, with service-stop applications of the brakes by the mechanism of patent 220,556, it was the intention of Mr. Westinghouse that they be made at some times without any appreciable pressure passing from the auxiliary reservoir to the brake-cylinder through the port or passage s^2 , and that only a very small, and probably an inappreciable, amount, would pass through this port, although possibly, when making a service-stop application by simply

continuing a graduating application, more than this inappreciable amount might pass through such port s^2 .

My reason for this is, that I should expect, with the length of train heretofore assumed, and when a graduating application is continued long enough, there would be a sufficient reduction of main air or train pipe pressure to overcome the difference in friction and move the slide-valves H sufficiently far, so that the port s^2 of no one of them would be in register with the port or passage C, although, in doing this, some of the slide-valves might be moved far enough to move the slide-valve H of some of the triple valves sufficiently far for such valve to partially uncover the port or passage C to a small extent, and thus permit part of the pressure from the auxiliary reservoir to pass through the port s^1 , and part of it through the uncovered portion of the port or passage C, when making a service-stop application of the brakes, with such plain triple valves.

355 X Q. You state that "what we have been pleased to term service-stop applications of the brakes can be performed in different ways by the mechanism shown in patent 220,556;" describe the several different ways in which such service-stop applications can be performed by said mechanism, including in your description a statement as to how the several parts move, and how the
401 several ports functionate during said different ways?

A. Service-stop applications of the brakes, as explained by me in my former deposition herein, and as I understand the term has been used herein, are applications of the brakes where the same are applied with the full force of auxiliary reservoir pressure, although possibly, in some instances, such is not the case. But even taking the term as meaning the admission, to the brake-cylinder, of auxiliary reservoir pressure sufficient to bring the train to a stop, I think it is manifest that service-stop applications of the brakes can be made in different ways by the mechanism shown in patent 220,556. Of course, we must bear in mind the fact, testified to by Mr. Church, one of defendants' experts, that the amount of fluid pressure which would be simply a graduating application of the brakes, may become, under other circumstances, a service-stop application. I mention this fact simply to show that possibly the term service-stop applications of the brakes, has not always been used with the understanding stated above. The different applications of the brakes, with plain triple valves like those shown in patent 220,556, are performed by the difference in extent of the reduction of main air or train pipe pressure by the engineer, and consist in the bringing of the valve H in different positions relatively to the port C. I have already described at length, the operations of this mechanism, and I will simply add that a service-stop application can be made with plain triple valves like those shown in patent 220,556, when the triple-valve pistons and slide-valves H, of those triple valves, are moved backward to the extent of their movement in that direction, as, for instance, if it was desired to stop the train on a considerable down grade, I should expect that it would be necessary to reduce the pressure in the main air or train pipe so that the triple-valve pistons would be moved backward to the extent of

402 their movement in that direction, and that the stopping of the train would be nothing more than what would be termed a service stop. That is, the train would be stopped without inconvenience to the passengers. The same reduction of main air or train pipe pressure used for making a service stop, on a considerable down grade might, on a considerable up grade, stop the cars too suddenly, and thus cause inconvenience to the passengers.

From the above, it will be seen that the conditions under which the brakes are applied vary so widely that it is wholly dependent upon the discretion of the engineer, just how, in each particular instance, he will apply the brakes, to accomplish the result he desires, and that there is no cast-iron rule by means of which he shall manipulate the engineer's valve or cock, and give a certain extent of movement to the parts of a triple valve, and because of this, the extent of movement of such parts will vary when making a service-stop application of the brakes, with triple valves like those shown in patent 220,556.

356 X Q. In making a service stop on a considerable down grade, why would the engineer reduce the pressure in the main air or train pipe, so that the triple-valve pistons would be moved backward to the extent of their movement in that direction, in using the brake apparatus described and shown in patent No. 220,556?

A. I have not attempted to give the reasons why an engineer would do one thing or another. The former question asked me as to different ways in which service-stop applications of the brakes can be made with the triple valve shown in patent 220,556, and I made answer to that question stating that a service-stop application could be made in the way described.

I suppose the engineer in this case, as in all others, would make a service-stop application, in whichever way it is made, because he wanted to do it that way, and could manipulate the apparatus at hand to so accomplish such result.

357 X Q. You stated more than that. You stated that 403 under the circumstances indicated in my last question you "should expect that it would be necessary to reduce the pressure in the main air or train pipe so that the triple-valve pistons would be moved backward to the extent of their movement in that direction." I want to know why you should expect that it would be necessary to reduce the pressure in the train-pipe so that the triple-valve pistons would be moved backward to the extent in their movement of that direction.

A. I should expect that he would want to apply his brakes under these circumstances with their full force, and that there should be no mistake about it even if some of the slide-valves had a greater amount of friction than he had reason to expect them to have, and also knowing that, by so doing, he would insure the full force at his command, and without interfering with the comfort of the passengers.

At the moment of answering the preceding question I overlooked the fact called to my attention in the present question, or it had for the moment escaped my mind.

358 X Q. Is it not also true that by reducing the pressure in the main air or train pipe, so that the triple-valve pistons would be moved backward to the extent of their movement in that direction, the brakes would be applied with their full pressure in a shorter time than they could be applied by bringing into use simply the port *s*¹ of patent 220,556?

A. Considering each triple valve alone, yes.

359 X Q. And is that not one of the reasons why the engineer, under the circumstances stated in your answer to X Q. 355 and in X Q. 356, might be expected to reduce the pressure in the train-pipe so that the triple-valve pistons would be moved backward to the extent of their movement in that direction?

A. No, I should not expect that it would. It is a well-known fact that, owing to dust or grit entering triple-valve mechanisms, the pistons themselves, or some part connected with them, at times fail to respond to the ordinary reductions of pressure which are calculated to move them, and I should expect that this would
401 be the main reason, and practically the only reason, so far as the sudden reduction of the main air or train pipe pressure is concerned, why the engineer would make such sudden reduction, and thus insure the full application of the brakes upon each and every car of the train, he knowing that a sudden reduction of main air or train pipe pressure would cause a piston, which might, under other circumstances, stick, to surely be moved backward, and apply the brakes upon that car, instead of failing to do so. Of course, he would take into consideration, under the circumstances named, that even with the brakes applied as quickly as possible with that mechanism, there would be no inconvenience to the passengers, and he would naturally want to obtain the full application of the brakes upon each and every car, and would make this sudden reduction, so that there would be no mistake or failure to obtain such full application of the brakes.

360 X Q. In thus reducing the pressure suddenly, so as to cause the triple-valve pistons to move backward to the extent of their movement in that direction, the valves H would pass from the ports C and open said ports wide open, would they not?

A. That will depend on just what is meant by the words "the valves H would move past the ports C." I find, from an examination of the drawings, that there is a difference in the movement of the valve H respectively to the port C in figures 1 and 4 of patent 220,556.

It is true that the valves H would uncover the ports C to the extent that they are capable of uncovering them. To this extent, my answer would be that they would.

361 X Q. And when the port C was thus uncovered to the extent that the valve H was capable of uncovering it, auxiliary reservoir air would flow to the brake-cylinder more quickly than it could flow through the port *s*¹, and would apply the brakes with their full force in a shorter time than they could be applied
405 with their force, by air passing through the port *s*¹; is this the fact?

A. This question is in substance identical with X Q. 358, and I shall have to answer it the same way, viz., considering each triple valve alone, yes.

363 X Q. In the Westinghouse patent 220,556, how does the cross-sectional area of the port C compare in size with the cross-sectional area of the port s^1 ?

A. I shall have to make some calculations in order to answer this question, but I call attention to the fact that there is a variation in different figures showing these parts, so that there is nothing definite that can be said upon the subject.

365 X Q. Please make the necessary measurements and calculations to enable you to answer my question tomorrow morning.

Adjourned to Thursday, December 7, 1893, at 10.30 a. m.

NEW YORK, December 7, 1893—10.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Cross-examination of HENRY F. NEWBURY resumed:

A. to 363 X Q. Before answering the question, I desire to say that upon further measuring the movement of the parts in figures 1 and 4 of the drawings of patent 220,556, I find that I was in error yesterday, and that the slide-valve H in both of those figures moves past the port C, so as to fully uncover such port or passage. I cannot say how this error occurred, but I am satisfied that it did occur, and desire that it be corrected, so far as possible.

I find the diameter of the port s^1 to be $\frac{1.2}{100}$ of an inch, which gives a cross-sectional area for such port .01130976 of a square inch.
406 I find that the port or passage C, of figure 1, has a diameter of $\frac{2.1}{100}$ of an inch, which gives a cross-sectional area of such port or passage of .03463614 of a square inch. The same port or passage C, in figure 3, I find to be $\frac{2.2}{100}$ of an inch in diameter, which gives a cross-sectional area of such port or passage of .03801336. The same port or passage C, in figure 4, I find is $\frac{1.9}{100}$ of an inch in diameter, which gives a cross-sectional area of such port or passage of .02834294.

From this it will be seen that the port s^1 is of the same cross-sectional area, while the cross-sectional area of the ports or passages C vary as above set forth.

In figure 1, the cross-sectional areas of the port s^1 and the port or passage C are .01130975 and .03463614 respectively. In figure 3, the same ports or passages compare as .01130976 is to .03801336. In figure 4, the same ports or passages compare as .01130976 is to .02834294.

I find that the passage connecting with the port s^1 , varies in size in the different figures, while the port s^1 is the same, therefore the capacity of the port s^1 , in the different figures, also varies as the cross-sectional area of the passage leading to the port s^1 is less than that of the port itself.

364 X Q. How does the capacity of the passage leading to the port s^1 compare with the port itself?

A. The cross-sectional area of the port s^1 , as above stated, is .01130976, in each of the several figures, and the cross-sectional area of the passage opening into the port s^1 , in figure 1, is .00950334. In figure 3, the cross-sectional area of the same passage is .00636174. And in figure 4, the cross-sectional area of the same passage is .007854.

I cannot determine from the several figures whether the passage leading from the valve chamber through the slide-valve H, and transversely to the above-named passage into which port s^1 opens, its opened sufficiently to give the passage into which the ports s^1 opens its full capacity of transmitting fluid pressure to such port.

365 X Q. Referring to the Boyden patent No. 280,285, the "always-open one-way passage" is therein described as follows:

"Extending from the drip-chamber is a passage D, provided with a check-valve, d , adapted at all times to allow compressed air from the train-pipe P^2 to reach the air reservoir on the car, but preventing its return therefrom, whereby no loss of fluid pressure from reservoir R^3 can occur in case of accidental separation of the car from the train, and serving also, as hereinafter explained, to allow compressed air from the train-pipe to reach the brake-cylinder C^3 while the brake is applied. As the fluid pressure can take but one direction in this passage, I call it 'an always-open one-way passage.' A passage substantially like this, always open for fluid pressure to reach the air reservoir on the car, constitutes one feature of my invention."

In the defendants' quick-action triple valves illustrated in plate IX (1889 catalogue) and plate XI (1891 catalogue), is there not a similar "always-open one-way passage," to wit, a passage always open for fluid pressure to reach the air reservoir on the car from the main air or train pipe, and in which passage the fluid pressure can take but one direction?

Objected to as immaterial.

A. The Boyden patent shows two forms of passages provided with a check-valve, which can be opened in one direction for the passage of air or fluid pressure from the main air or train pipe to the air reservoir, or, as heretofore termed, the auxiliary reservoir, upon the car. Applying the description above quoted generally to such passage and check-valve as a feeding-in passage, defendants' quick-action triple valves do have such an always-open one-way passage, or feeding-in passage, for the admission of main air or train pipe pressure to the auxiliary reservoir.

366 X Q. In said Boyden patent No. 280,285, if the capacity of the port R were so restricted as only to be equal to about one-third or one-half of the capacity of the port or passage C^1 , then, upon a sudden reduction of air pressure in the train-pipe, sufficient to move the valve H backward to the limit of its movement in that direction and thereby fully uncover the passage C^1 , the exhaust of air pressure

from the chamber containing the valve H into the brake-cylinder through the passage C¹ would so reduce the air pressure in said chamber as to cause the train-pipe pressure to unseat the check-valve in the passage D, and admit train-pipe air directly from the train-pipe, through the passages D, R¹ and C¹, to the brake-cylinder, at the same time that auxiliary reservoir pressure would be flowing through the restricted port R and the passages R¹ and C¹, to the brake-cylinder; am I not correct?

A. I am not prepared to answer this question, for the simple reason that I cannot say at once whether restricting the port R to the extent stated would produce the result assumed or not, and would not feel justified in answering the question without full investigation and satisfying myself upon the actual operation of the whole mechanism when only the change suggested was made.

The mechanism of this Boyden patent is a complicated mechanism, and depends upon a great many circumstances for its operation, some of which are not present in any other mechanism that I know of. If I am given the actual mechanisms, with the necessary time and facilities to investigate the subject, I will then be pleased to answer the question, but until then I do not feel justified in attempting to do so, owing to the lack of sufficient data upon which to form an intelligent opinion.

409 367 X Q. Upon such data as you already have, can you not form any opinion on the subject of my last question?

A. No, not that I would feel justified as terming an opinion. I could make a wild guess, which would not be of any value whatever, and that is all.

I have learned enough about the operations of different mechanisms, operated by varying fluid pressure therein, to know that there are so many conditions which enter into the problem that when I thought I understood the operation of one of these kinds of mechanisms, under changed conditions, I found afterward that I had omitted to consider some fact essential to the matter, and therefore, I have thought it necessary to experiment with the changed mechanism, and prove the correctness of my opinions as to their operations, before feeling justified to state my conclusions concerning such structures, or at least to have experimented in the direct line of the changes, with mechanisms which confessedly operate in the same way.

368 X Q. With your present information, does your mind incline to answer X Q. 366 in the affirmative or in the negative?

A. My mind is in such a state that I cannot say one way or the other, and, upon actual test, should not be surprised in the least whether you would be found correct or incorrect in the assumption you have made in said X Q. 366.

369 X Q. If in said X Q. 366 I had assumed the capacity of the port R to be still further reduced, say, so as to be equal only to one-tenth of the capacity of the port or passage C¹, would it enable you to form an opinion on the subject of my question?

A. I even then should not care to express an opinion upon the matter, for the reason, as before stated, there are other matters

which enter into the problem, which are not present in any mechanism which I have ever seen operated or experimented with. I have no hesitation in saying that the port R and the other
 410 passages, by means of which auxiliary reservoir pressure reaches the brake-cylinder, might be so proportioned, relatively one to the other, that the check-valve *d* would be unseated when the valve H fully uncovered the port or passage leading to the brake-cylinder. This, of course, also requires proportioning the strength of the spring holding the check-valve *d* seated. This is as far as I would care to go, without something more definite than I have now before me, regarding the apparatus of the said Boyden patent.

It will be remembered that there is nothing whatever in the Boyden patent relating to any such changed construction as has been suggested by counsel.

370 X Q. Would it require proportioning the spring any differently from what it is proportioned in said structure of the Boyden patent referred to?

A. It might, or it might not, as the proportioning of the spring in said Boyden structure is a very indefinite thing, and might be such as would require a different proportioning under the changed condition from what it is there.

To explain my meaning, I believe that a spring can be placed to hold the check-valve 26, of defendants' quick-action triple valves seated, so that the main air or train pipe pressure will not enter the brake-cylinder directly when one spring is used, where it would so enter when another spring was used, and, in both cases, the said quick-action triple valves would serve as triple valves proper or plain triple valves.

371 X Q. In your answer to Q. 234, you quote certain matter which at one time stood in the specification of the application of Mr. Westinghouse for patent No. 360,970, and which was canceled by the same communication that inserted in said specification the disclaimer quoted in Q. 234. You also state in said answer that you have, at all times, been of the understanding that a quick-action triple valve, in which the function of admitting main air or
 411 train pipe pressure directly from the main air or train pipe to the brake-cylinder, was performed by a valve which was integral with the main valve, and formed by an extension thereof, would be included within the invention of the patent in suit, because it would embody the essential operative features of such invention.

In forming your opinion as to the scope of the claims sued upon, have you regarded the cancellation of those words which were originally embodied in Mr. Westinghouse's specification and were afterward cancelled as aforesaid, as amounting, in effect, to a disclaimer?

Objected to as being wholly a question of law and not therefore competent.

Defendants' counsel states that the witness has necessarily been

obliged to deal with the question of the scope of the claims in suit or, at least, to give his testimony upon some theory as to the scope of said claims, and the present question merely seeks to ascertain whether or not he has treated said cancellation as in any way limiting the scope of the terms used in the claims in suit.

Counsel for complainants replies that the witness' understanding of the scope of the claims in suit, so far as relates to the canceled subject-matter referred to, has been very clearly indicated by his testimony referred to in the question, and therefore, whether or not said canceled subject-matter amounts in law, and in effect, to a disclaimer, is altogether immaterial. If the court should so hold, it will of course reject the witness' testimony relating to the inclusion of such canceled subject-matter in his view as to the scope of the claims, and if not, it will probably accept it. Moreover, the question does not ask as to limitation of the scope of the claims by the cancellation of such matter, but asks, in terms, whether such cancellation amount in effect to "a disclaimer."

412 Defendants' counsel says that, of course, the court is the sole judge of the legal question involved; but if the witness, in his direct examination, has seen fit, as complainants' counsel states, to indicate his understanding of the scope of the claims in suit so far as relates to the canceled subject-matter referred to, then it follows that defendants' counsel has a perfect right to cross-examine him upon the matter referred to, and it was with this view that defendants' counsel dictated the present interrogatory.

A. No, I have not, for, as I understand such matters, the simple cancellation, in a specification, of matter not in any way brought about by the prior state of the art, does not in any way affect the scope of the invention, and such cancellation does not, in any way, affect the natural and obvious understanding to be had of the claims. That is, such a cancellation of matter is simply the same as if it had never been put into the specification, or had never existed.

372 X Q. And it is with that understanding that you have given your testimony in this case, is it?

A. It is, as I before stated. I knew of such cancellation, and had it in mind before giving my former testimony, and had such in mind when I was cross-examined as to my understanding of the terms found in the specification and claims of the patent in suit in such former deposition.

373 X Q. In the case of George Westinghouse, Jr., and The Westinghouse Air Brake Company, vs. The New York Air Brake Company, Isaac B. Newcombe, Royal C. Vilas, Charles A. Starbuck, and John C. Thompson, directors, in equity, in the circuit court of the United States in and for the southern district of New York, and on the 16th day of December, 1891, as it appears by the printed record of the pleadings and complainants' proofs in that case, on 413 pages 143 and 144 thereof, you were asked the following question and gave the following answer:

"96 X Q. Is it not now obvious to you that 360,070 is the pioneer patent for the automatic quick-action brake system, which consists

essentially of a train-pipe connected to the brake-cylinder by the usual service-stop passage, and also connected to the brake-cylinder by an emergency-stop passage.

"A. It is not now obvious to me that patent 360,070 is the pioneer in the sense that it contains claims broad enough, under any interpretation which I understand to be allowable, to cover all forms of quick-action automatic systems of brakes.

"The facts set forth in this cross-examination were not new to me when I gave my former deposition, and they produce no greater impression on my mind now than they did then.

"We have to take the patents as we find them, not as they might have been."

This is a correct copy of the said cross-question and your answer thereto, as printed in said record, is it not?

Objected to as irrelevant, immaterial and not proper cross-examination.

A. I believe that the language quoted in the question is correctly copied from the printed record of suit No. 4977, referred to in the question.

374 X Q. What patents were sued upon in that suit?

Same objection.

A. There were three patents set up in the bill, namely, Nos. 376,837, 168,359 and 172,064.

HENRY F. NEWBURY.

Adjourned to Monday, December 11, 1893, at 11.30 a. m.

414 NEW YORK, *December 11, 1893*—11.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

H. H. WESTINGHOUSE, being recalled, deposes and says, in answer to interrogatories propounded to him by J. Snowden Bell, Esq., of counsel for complainants, as follows, to wit:

375 Q. Are you the same H. H. Westinghouse who has heretofore testified in this cause?

A. I am.

376 Q. Have you read the depositions of defendants' witnesses, George A. Boyden and Joseph B. Church, in this cause?

A. I have.

377 Q. As a practical expert in the art of automatic air brakes for railroads, please state the distinguishing and essential characteristics of a "triple valve," as such appliance was used in said art prior to 1887, and with special reference to its several functions?

A. The distinguishing characteristics of the triple valves used prior to the time stated, was a construction of the mechanism that provided for passages or connections between a train-pipe and an auxiliary reservoir, between an auxiliary reservoir and brake-cylinder, and between the brake-cylinder and the atmosphere.

The distinguishing features of operation were that the passage leading from the train-pipe to the auxiliary reservoir should be open, when the passage leading from the auxiliary reservoir to the brake-cylinder was closed, and that the passage leading from the train-pipe to the auxiliary reservoir should be closed, when the passage leading from the auxiliary reservoir to the brake-cylinder was open. It was also necessary that the passage leading from the brake-cylinder to the atmosphere should be closed when the passage from the auxiliary reservoir to the brake-cylinder was open.

415 These are the essential characteristics of triple-valve construction and operation prior to 1887.

378 Q. So far as the means for admitting pressure from the auxiliary reservoir to the brake-cylinder are concerned, in triple valves as known prior to 1887, what was the only essential consideration, structurally, in that regard?

A. The only essential requirement was a port or passage, leading from the auxiliary reservoir to the brake-cylinder, that was opened, when the port leading from the train-pipe to the auxiliary reservoir was closed, and which was closed, when the port leading from the train-pipe to the brake-cylinder was open. In the art of manufacturing triple valves, there were detailed modifications in the valve arrangements which controlled the flow of air through the various ports and passages of the triple-valve structure, and these changes were made for the purpose of rendering the operation of the original form of triple-valve construction more satisfactory in its practical operation.

The most important of these modifications relates to capability of admitting less than the maximum air pressure from the auxiliary reservoir to the brake-cylinder, as this capability is the one that provides for the application of brakes with a graduated or maximum force as may be required.

This important function is obtained by a valve arrangement that permits of the opening and closing of the passage leading from the auxiliary reservoir to the brake-cylinder, without opening either the passage leading from the train-pipe to the auxiliary reservoir, or from the brake-cylinder to the atmosphere.

The improvement described is well illustrated in the triple valve shown in the patent No. 168,359 to George Westinghouse, Jr.

Patent No. 172,064 to George Westinghouse, Jr., shows a further improvement in triple-valve construction, in which some of the difficulties inherent in the use of a slide-valve, in triple-valve construction, are provided for. In the two constructions referred

416 to, there is but a single port or passage connecting the auxiliary reservoir with the brake-cylinder controlled by a single valve.

Patent No. 220,556 illustrates a further improvement in triple-valve construction, the object of the improvement being to increase the capability of the structure, in the direction of admitting limited amounts of air from the auxiliary reservoir to the brake-cylinder, when a maximum application of the brakes was not desired.

The triple valve in this patent has a single passage leading from

the auxiliary reservoir to the brake-cylinder, controlled by a valve, which valve may be operated to admit air from the auxiliary reservoir to the brake-cylinder with different degrees of rapidity, depending upon which portion of the valve controls the passage leading from the auxiliary reservoir to the brake-cylinder, and upon the manner in which the valve is operated.

The control of the passage leading from the auxiliary reservoir to the brake-cylinder, by more than one portion of the valve mechanism, is a mechanical convenience, in this structure, and is not an essential feature, or of any operative value. The effect produced by the double control of this port is equally well provided by a single control, when the parts are properly proportioned.

Patent No. 243,415 to George Westinghouse, Jr., illustrates a form of triple valve in which the passage leading from the auxiliary reservoir to the brake-cylinder is controlled by a valve having but a single capability of admitting air from the auxiliary reservoir to the brake-cylinder. This valve, so far as relates to the control of the passage leading from the auxiliary reservoir to the brake-cylinder, has all the practical advantages and capabilities of the valve shown in the patent 220,556, and was the latest form of triple valve, and the kind of which the largest number were in use prior to 1887.

379 Q. How many valve-controlled ports, passages, or channels, for the traverse of air under pressure from the auxiliary reservoir to the brake-cylinder, were required in a valvular appliance known prior to 1887, in order to enable it to be fully and truly a "triple valve," and to perform all of the then known functions of such an appliance?

A. One.

380 Q. To what extent, if at all, would the addition of one or more passages for reservoir air to the brake-cylinder to the one which you say is necessary, bear upon the question of whether or not the valvular appliance was what was termed a "triple valve" prior to 1887?

A. It would have absolutely no bearing upon the question.

381 Q. In your answer to Q. 378, referring to patent 220,556, you say that the effect produced by the double control of the port leading from the auxiliary reservoir to the brake-cylinder is equally well provided by a single control, when properly proportioned.

Can you illustrate your meaning by giving an instance of such a proportioning of the parts in this patent as would provide the same effect, by a single control of the port, as is provided in the patent by the capability of a double control?

A. In the construction shown in patent 220,556, when communication between the auxiliary reservoir and the brake-cylinder is established, by bringing port *s*¹ to register with the port C, the flow of air from the auxiliary reservoir to the brake-cylinder will be less rapid than would be the case when port C is entirely uncovered by the complete movement of slide-valve H in a downward direction, for the reason that the port *s*¹ is of smaller diameter than port C, when port C is completely uncovered by slide-valve H.

If it were desirable, or mechanically convenient, to make port *d* of the same size as port C, the same operative results would be obtained, with a single control of port C, that may, under some circumstances, be obtained by means of double control.

418 381½ Q. Are you familiar with the descriptive matter and representations of a quick-action triple valve contained in the specification and drawings of the Westinghouse patent No. 360,070 in suit? In answering this, and any other questions which I may put to you regarding this or any other patent, you may understand that you are not interrogated as to the *claims*, and need not refer to them.

A. I am.

382 Q. In his answer to Q. 6, in which he is asked to describe the construction and operation of the quick-action triple valve of the Westinghouse patent 360,070 in suit, defendants' witness G. A. Boyden makes the following statement, to wit:

"This is a valve mechanism used in automatic air brakes, the functions of which are: 1st. To admit air from the main air pipe to the auxiliary reservoir, through the valve port or feeding-in groove 51, shown in Fig. 2 of complainants' patent No. 360,070. 2d. To admit air from the auxiliary reservoir to the brake-cylinder through the port controlled by the graduating valve 29, by the preliminary movement of the piston 12. 3d. To admit auxiliary reservoir air to the brake-cylinder through the valve port 35 by the final movement of the piston. 4th. To exhaust air from the brake-cylinder to the atmosphere through the valve cavity 33. These four valves form what is commonly known as a 'triple valve' proper, as used in the art prior to 1887."

From your practical knowledge of the construction and operation of quick-action triple valves similar to that described and shown in patent 360,070, as well as your familiarity with the descriptive matter and drawings of said patent, state whether or not the statement of Mr. Boyden above quoted is true and correct in fact.

419 A. Mr. Boyden's statement with respect to the use of valve port 35 is incorrect. The presence of such port, or the functions performed by it, was no essential part of triple-valve construction prior to 1887.

383 Q. What, if any, function is performed by the valve port 35 of the quick action triple valve of patent 360,070, in any operation of said appliance in performing the function of a triple valve proper as used in the art prior to 1887?

A. None.

384 Q. Is it or not physically possible for the valve port 35 to perform any function whatever, in any operation of the appliance of patent 360,070 as a triple valve proper, as used in the art prior to 1887, and if not, why not?

A. No, for the reason that all of the functions of a triple valve proper are performed in the appliance of 360,070 without bringing the port 35 in a position to perform any function whatever. That

is to say, during the operations of the appliance of 360,070 as a plain triple valve, the port 35 has no function.

385 Q. When, and under what circumstances only, does or can the port 35 perform any function?

A. Only when the triple-valve piston of the appliance of 360,070 has moved beyond the limit required for its operation as a triple valve proper, and caused communication to be opened directly from the train-pipe to the brake-cylinder.

386 Q. In his answer to Q. 6, Mr. Boyden states (pp. 18, 19) that "To apply the brakes fully with the auxiliary reservoir pressure by the final movement of the piston 12, a sufficient amount of air is gradually exhausted from the main air pipe to move the piston its full stroke. This will bring the valve port 35 coincident with the passage 22 and thereby establish communication from the auxiliary reservoir to the brake-cylinder and fully apply the brakes with the reservoir pressure."

Is or is not this statement of Mr. Boyden's true and correct in fact?

420 A. The statement of Mr. Boyden is incorrect. The intent of this statement is to make it appear that in practical operation, when it is desired to get full auxiliary reservoir pressure in the brake-cylinder, it is necessary to cause the triple-valve piston to move so that the port 35 will register with port 22, when, as a matter of fact, if such operation is desired, it can only be done by moving the triple-valve piston to a position that will cause port 31 to register with port 22. When port 35 is in the position described by Mr. Boyden, valve 41 will also be open; and the air in the brake-cylinder will be combined train-pipe and auxiliary reservoir air.

387 Q. As a matter of fact, is any such operation as the gradual exhaustion of air from the main air pipe to move the piston its full stroke, in order to apply the brakes fully with the auxiliary reservoir pressure by the final movement of the piston 12, either prescribed in patent 360,070 or performed in the actual operation of quick-action triple valves similar to the appliance of said patent?

A. No.

388 Q. To what extent do you agree with Mr. Boyden's statement in folio 75 page 19 (D. R.) as to the "essential features" of the quick-action triple valve of patent 360,070?

A. I substantially agree with Mr. Boyden as to the first of the essential features, with some limitations, and disagree with him as to the second.

389 Q. To what extent do you agree with Mr. Boyden's statement in folio 82, p. 21 (D. R.) as to the "essential features" of defendants' quick-action triple valves, plate XI 1891 catalogue?

A. I agree with him as to the first of the essential features, with some limitations, and I disagree with him as to the second.

390 Q. As a practical expert in quick-action automatic brakes, please state what you consider to be the "essential features" of practical operation of the quick-action triple valve of patent

421 360,070, and state to what extent you find the essential features of practical operation of defendants' quick-action triple valves (plate IX 1889 catalogue and plate XI 1891 catalogue) to be in correspondence with those of the quick-action triple valve of patent 360,070?

A. There are two essential features in practical operation of the quick-action triple-valve structure shown in the patent 360,070. One of them is, that all of the function of triple valves as performed prior to 1887, must be obtained by means of the travel of the triple-valve piston through a limited portion of its stroke. Second, that the travel of the triple-valve piston for a greater distance than is required to perform the operations of a triple valve prior to 1887, will cause air from the train-pipe to enter the cylinder directly.

I find these essential features of operation of the appliances of 360,070, in the defendants' quick-action triple valves as shown in plate IX defendants' 1889 catalogue and plate XI defendants' 1891 catalogue.

391 Q. To what, if any, material extent or degree do such structural differences as may exist between defendants' quick-action triple valves and that of patent 360,070, affect the identity of the essential features of practical operation which you state to exist in your last answer?

A. Such structural differences as exist in the two devices do not affect their practical operative identity.

In each case the triple-valve piston moves within definitely defined limits to perform the functions of triple valves prior to 1887, and, in each case, it is essential that the piston should make a further travel before air from the train-pipe can directly enter the brake-cylinder.

392 Q. In his answer to Q. 12, defendants' witness J. B. Church, alleges that there is a difference "in principle or mode of operation" between the device of patent 360,070 and the defendants' device.

Please state whether or not this assertion of Mr. Church is

422 correct or well-founded, and if it is not, state what you understand to be the "principle" or "mode of operation" of the appliance of patent 360,070, and state in what, if any, particular, either of principle or mode of operation, the defendants' quick-action triple valves differ from the appliance of patent 360,070.

A. Mr. Church is incorrect in his statement that there is a difference in principle or mode of operation in the defendants' quick-action triple valves, as compared with the appliance shown in 360,070.

It is essential to the practical operation of both of these quick-action triple valves, that they shall perform the functions of plain triple valves, and, in addition thereto, that under certain conditions, air from the train-pipe shall pass into the brake-cylinder. It is also necessary that air from the auxiliary reservoir shall also pass into the brake-cylinder to unite with the air that has entered from the train-pipe. It is also essential that when air from the reservoir enters the brake-cylinder and causes the pressure to become higher than the air in the train-pipe, that a check-valve, or its equivalent, shall prevent the flow of pressure from the brake-cylinder, into the train-pipe.

These are the essential operative requirements of the structures referred to.

In all of the structures referred to, the functions of the plain triple valves are performed in substantially the same manner by the traverse of the triple-valve piston with some of its valves through a portion of its travel. In every instance, when it is desired that air from the train-pipe should enter the brake-cylinder, it is necessary that a further traverse of the triple-valve piston shall be caused to take place, for the purpose of opening communication directly between the train-pipe and the brake-cylinder, so that air may pass from the train-pipe to the brake-cylinder without first entering the auxiliary reservoir.

To render it possible for air from the train-pipe to flow into the brake-cylinder, when there is open communication between them, it is essential that the pressure in the brake-cylinder should be less than that in the train-pipe, and if there is not a considerable
423 difference in these pressures, the intended operation of the structures will be defeated. In the operation of these quick-action triple valves to open direct communication from the train-pipe to the brake-cylinder, by means of the further traverse of the triple-valve piston, the construction of the devices in question is such, that communication is open between the auxiliary reservoir and the brake-cylinder, before direct communication is made between the train-pipe and the brake-cylinder, and some air from the auxiliary reservoir enters the brake-cylinder before the direct communication is established.

If the passage leading from the auxiliary reservoir to the brake-cylinder, which is opened by the movement of the triple-valve piston before direct communication is made between the brake-pipe and the brake-cylinder, were not restricted in size, the operation of these constructions for the purpose of causing air to enter directly from the train-pipe to the brake-cylinder could not be performed, for the following reasons:

It is primarily essential that the triple-valve piston shall move a greater distance to open direct communication between the train-pipe and the brake-cylinder, than it is required to move in performing plain triple-valve functions. In the structures in question, to cause the piston to move a greater distance, it is essential that a greater force should be made available to overcome the resistance of the piston, to travel beyond the point necessary for plain triple-valve work. The force available for moving the triple-valve piston is brought into action by creating a difference of pressure on the opposite sides of the triple-valve piston. For the purposes of *applying* brakes, pressure is reduced on the train-pipe side of the triple-valve piston, and, if but a portion of its travel is required, as in the making of graduating applications of the brakes, a moderate reduction of pressure is made in the train-pipe, which causes the piston to move to a point at which communication is opened between the auxiliary reservoir and the brake-cylinder. The fall of
424 pressure on the inner or reservoir side of the triple-valve piston, combined with the definite resistance which the pis-

ton meets at this point, causes it to stop in its travel, and when the pressure in the auxiliary reservoir has been reduced by its expansion into the brake-cylinder, to a point where it is slightly lower than the pressure on the train-pipe side, the piston will then move in a direction to close the opening between the auxiliary reservoir and the brake-cylinder.

To effect the further travel of the triple-valve piston, so that direct communication can be made between the train-pipe and the brake-cylinder, it is necessary that a reduction of pressure be made, on the train-pipe side of the triple-valve piston, sufficiently greater than that on the auxiliary reservoir side, to overcome the resistance to further travel beyond the plain triple-valve position, caused by the pressure of air on the back of valve 22 in defendants' 1891 valve, and valve 15 of defendants' 1889 valve, and by the spring 39 and friction of the slide-valve 41, in the structure shown in patent 360,070.

To cause this difference of pressure, it is necessary that air pressure be lowered on the train-pipe side of the triple-valve piston, by the opening of the engineers' valve, more rapidly than it is made on the auxiliary reservoir side by the passing of air from the auxiliary reservoir to the brake-cylinder, and, to enable the necessary difference of pressure to be obtained, it is essential, in all of the structures in question, that the flow of air from the inner side of the triple-valve piston shall be restricted when communication is made between the auxiliary reservoir and brake-cylinder.

In the defendants' 1891 quick-action triple valve, the proper flow of air from the auxiliary reservoir to the brake-cylinder is regulated by the size of port B and in the 1889 quick-action triple valve by a similar port e.

In the structure shown in patent 360,070 the proper proportioning of ports 35 and 31 accomplishes the same result, and in the same manner.

425 While it is essential, in these structures, that the further travel of the piston should open direct communication between the train-pipe and the brake-cylinder, it has already been pointed out that such opening would accomplish no useful result, unless, at the time of opening the direct communication between the train-pipe and the brake-cylinder, the pressure in the brake-cylinder should be somewhat less than the pressure in the train-pipe.

Each of the structures in question has a non-return check-valve, located in the line of direct communication between the train-pipe and the brake-cylinder. During the period of the application of the brakes by means of the plain triple-valve portion of the structures, this check-valve is held to its seat, in a direction to prevent the flow of air from the train-pipe to the brake cylinder. It is essential in each of these structures, when it is desired that direct communication should be made between the train-pipe and the brake-cylinder, that the force that keeps the check-valve to its seat shall be reversed so that the check-valve will be opened, permitting air to flow directly from the train-pipe to the brake-cylinder.

In defendants' 1891 quick-action triple valve, this check-valve is designated by the numeral 26, and, in defendants' 1889 quick-action triple valve, by the numeral 9. In the structure shown in patent 360,070, this check-valve is indicated by the numeral 49.

In the defendants' structures, when the complete travel of the triple-valve piston is made for the purpose of opening direct communication between the train-pipe and the brake-cylinder, the opening of valve 22 (15) by this further movement, causes a considerable reduction of pressure on the inner side of check-valve 26 (9) because of the relatively larger size of the opening controlled by valve 22 (15) as compared with port B (c).

Adjourned to Tuesday, December 12, 1893, at 10.30 a. m.

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NEW YORK, *December 12, 1893*—10.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

The deposition of the witness, H. H. Westinghouse, is here suspended, by consent, to admit of the examination of Mr. T. J. Hogan, who is about to leave the city.

THOMAS J. HOGAN, a witness produced on behalf of complainants, being duly sworn, deposes and says, in answer to interrogatories propounded to him by J. Snowden Bell, Esq., of counsel for complainants, as follows, to wit:

393 Q. What is your name, age, residence, and occupation?

A. Thomas J. Hogan, am over 38 years of age; residence, Pittsburgh, Pa.; and am a mechanical engineer.

394 Q. State the nature and extent of your education and experience as a mechanical engineer, and of your experience, if any, with automatic air brakes?

A. My education and experience as a mechanical engineer was obtained at the United States Naval Academy at Annapolis, Maryland, where I went through the full course for cadet engineers, and graduated in the year 1883, and was, from that time, an officer in the engineer corps of the United States Navy, until about October, 1886. I was not in active service from July, 1884, until March, 1886, but was during that time on waiting orders. From about the first of August until the 12th of October, 1886, or within a few days of that time, I was in active service on board the cruiser "Atlanta," and took part in the test of the machinery on board of the "Atlanta."

During part of the time that I was on waiting orders, I was assistant examiner in the division of steam-engineering in the
427 United States Patent Office, that is, from October 9, 1884, until some time in July, 1886, and, after resigning from the United States Navy about the middle of October, 1886, I returned to the Patent Office in the same position October 16, 1886, and remained in that position until January, 1890. In April, 1885, the class of steam and air brakes was assigned me for examination, and I continued to examine that class until I left the Patent Office, which was, I think, some time in July, 1886. On my return to the

Patent Office, in October, 1886, or shortly after, the class of steam and air brakes was again assigned to me, and I continued to examine that class, (the title of which was afterwards changed to fluid-pressure railway brakes) during the remainder of my time in the Patent Office.

Since leaving the Patent Office, I have been employed by the Westinghouse Air Brake Company, in connection with work in the preparation of applications for patents on fluid-pressure brake devices, and, in that time, have had a good deal of experience in the preparation of specifications and claims of patent applications, and also in connection with tests of brake devices.

395 Q. By reference to the copy of file-wrapper and contents of the Westinghouse patent No. 360,070 in suit, I find an official letter therein dated January 14, 1887, bearing the signatures "F. Fowler, ex.," and "T. J. Hogan."

Please state whether you are the T. J. Hogan whose signature appears on this letter, and whether the examination of this application was made by you.

Objected to as immaterial and irrelevant.

A. The examination of that application was made by me, and there is on file in the Patent Office a letter written by me on that date and bearing my signature.

396 Q. I also find in the said certified copy an amendment dated January 19, 1887, and endorsed "Amend't B. Filed Jan. 20, 1887,"

in and by which amendment the applicant's attorney canceled the following subject-matter, which appeared between lines 21 and 29, page 13, of the specification as filed, to wit:

"Further, while in the specific construction described and shown, the function of admitting air from the main pipe is performed by a valve separate from that which effects the preliminary admission of reservoir pressure to the cylinder, a modification in which the same office is performed by a valve integral with the main valve and formed by an extension thereof, would be included in and embody the essential operative features of my invention."

I also find that the same amendment inserted a disclaimer, which appears between lines 94 and 103, page 4, of the patent.

Please state, first, whether or not any oral hearing or hearings was or were accorded by you to the applicant's solicitor, in the course of the application for patent 360,070, which are not noted upon the record of said application, and, second, under what circumstances or conditions the cancellation above referred to came to be made?

Objected to as incompetent, irrelevant and immaterial.

A. There were oral hearings in connection with the application, from a short time after it was filed, at different times, until a short time before the application was patented.

In connection with the canceled paragraph, among other things, the hearings related to the question as to whether the attorney would prefer to cancel the paragraph which referred to modifica-

tions not shown in the drawings, or whether he would illustrate it by an additional figure or figures in the drawing.

I don't know that he was requested to do either of these things, but I know that his attention was called to the fact that the practice in the office required him to do one or the other.

397 Q. To what extent was the rule of the office requiring descriptive matter in the specification, not illustrated in the drawings, to be either illustrated or canceled, enforced in the division of steam engineering, during your term of service therein as assistant examiner?

Objected to as irrelevant and immaterial.

A. I think it was enforced in every instance, except, perhaps, in some case of carelessness or oversight, and, while it was the rule based on decisions of the Commissioner of Patents, and was the general practice in the office, in other divisions, there was one particular reason, in addition, why it was always insisted upon in that division, and that reason was, that by having all of the modifications shown in the drawing, the examiners, in looking for references, were able to make an examination more easily and quickly than they would be able to do if they had to refer to the specification.

398 Q. In case the applicant's attorney had neglected to either cancel the paragraph referred to, or to illustrate it by an additional figure or figures in the drawings, after his attention had been called to the fact that the practice in the office required him to do one or the other, what would have been your duty, and what would you have done in the premises?

Objected to as hypothetical, incompetent, irrelevant and immaterial.

A. My duty would have been to require the attorney either to cancel the descriptive matter or to illustrate it in the drawings. I suppose I would have required him, ordinarily, either to cancel the descriptive matter or to illustrate it in the drawings.

399 Q. In what manner or how would you have made this requirement?

430 Same objection, and further objected to because the question is based upon a mere supposition contained in the preceding answer.

Counsel for complainants suggests that inquiries addressed to a former officer of the United States Patent Office, relatively to the nature and scope of his duties as such officer, in connection with subject-matter in this cause, are free from the objections urged by defendants' counsel, and further, that it clearly appears, from the witness' last preceding answer, that he has stated what he believes his action would have been in the performance of such duties.

A. I would have made it by means of an official letter.

400 Q. To what, if any, prior patent did the clause of disclaimer inserted by amendment B refer?

Objected to as incompetent.

A. It referred to patent No. 280,285, granted to G. A. Boyden Ju 26, 1883, at the time that the official letter of January 14th, 1883 was written, and, after that, the attention of the attorney was called to a similar construction to that shown in the patent to Boyden being illustrated in patent No. 163,242 to C. H. Perkins, May 1, 1875.

401 Q. In calling the attention of the applicant's attorney to the fact that the practice of the office required him either to cancel the paragraph referred to in Q. 396 or to illustrate it, did you do so with the intention of requiring that said subject-matter should be disclaimed, in and by the cancellation, if the attorney elected to pursue that course, or did you understand that such cancellation would be or operate as a disclaimer of such subject-matter?

431 Objected to as leading, incompetent, and, so far as concerning the witness' understanding, at the time, immaterial.

A. There was no connection between the cancellation of the paragraph and the construction shown in the patents to Boyden and Perkins, so far as any requirement of mine was concerned. The cancellation of the paragraph, appearing in the same amendment with the disclaimer, indicates that the disclaimer referred to something else besides what was contained in the canceled paragraph. If the disclaimer was intended merely to cover the construction referred to in that paragraph, the disclaimer would be unnecessary when the paragraph was canceled.

I have no knowledge of requiring any disclaimer whatever, but I know that the terms of the claims rejected described subject-matter which, while intended for a different purpose, and not performing the same function as in the application of patent 360,070, was shown in the patents to Boyden and Perkins.

All that part of the foregoing answer from and after the words "was concerned," to and including the words "when the paragraph was canceled," further objected to by defendants' counsel, as being not fact, but a mere supposition, inference, or argument of the witness, and therefore entirely incompetent.

Cross-examination *de bene esse* :

402 X Q. When you left the Patent Office in January, 1890, did you go immediately into the employment of the Westinghouse Air Brake Company?

A. I did, but was not in their offices. I went to work in the office of Mr. George H. Christy, and under his direction, and so far as I knew at the time, I was being employed by him.

403 X Q. You resigned your position in the Patent Office to go into Mr. Christy's employment?

Objected to as irrelevant and immaterial.

432 A. Yes, sir. The only communication I had with any one on the subject before leaving the Patent Office was with Mr. J. Snowden Bell, who was associated with Mr. Christy in his business, and with Mr. Christy himself, through personal interviews with both of these gentlemen in Washington, D. C., the understanding being that I was to be employed to attend to and perform whatever work might be required of me in connection with their patent business.

404 X Q. How long did you remain in Mr. Christy's office?

A. I remained there up to the present time, and am still in his office, although I am employed by the Westinghouse Air Brake Company.

405 X Q. How long after you entered Mr. Christy's office before you ascertained that you were employed, not by Mr. Christy, but by the Westinghouse Air Brake Company?

Same objection, which is continued without further notice to this line of examination.

A. In reply to that question, and also to correct what might be an inaccuracy in my answer to X Q 402, I will say that about six months after I left the Patent Office, I was informed that I was partly in the employment of the Westinghouse Air Brake Company, and while I stated, in answer to 402 X Q., that I went immediately into the employment of the Westinghouse Company, I did not know it at the time, and was not informed until about six months later, and was not given to understand then that I was exclusively employed by them. The question came up I think in July of 1890, about the time that I had obtained some patents of my own on air-brake appliances. Previous to that time, and for some time after that, I had done a great deal of work in connection with the preparation and prosecution of applications before the Patent Office, the
433 subject-matter of which had nothing whatever to do with air-brake appliances, or with the work of the Westinghouse Air Brake Company.

I think that Mr. Christy's business was such that he was required to increase the force in his office, and that that was the reason why I was employed by him, but I do not think his original intention was to employ me on work exclusively for the Westinghouse Air Brake Company. I know that I was not exclusively confined to air-brake work for some time after I discovered that I was partly employed by the air-brake company.

405 X Q. In answer to Qs. 400 and 401, you state, in substance, that the terms of the claims rejected in the Westinghouse application for patent 360,070, describe subject-matter shown in the patent to Perkins, No. 163,242, dated May 11, 1875, although, in said Perkins patent, said subject-matter was intended for a different purpose and did not perform the same function as in said Westinghouse application; what rejected claims of the Westinghouse application did you there refer to?

Objected to as irrelevant, immaterial and not proper cross-exami-

nation, the witness not having been interrogated in chief as to the claims of the patents referred to in the question, or of any other patents, and it not being competent for him to construe said claims.

Defendants' counsel states that the witness gave the testimony referred to, without objection from complainants' counsel, and it is therefore proper subject for cross-examination.

A. In reply to question 400 I mentioned patents to Boyden and Perkins, but made no reference to the construction shown in these patents, as being embodied in, or coming within the claims of application of patent 360,070, but, in reply to Q. 401, I stated that the terms of the claims rejected describe subject-matter, which, 434 while intended for a different purpose, and not performing the same function as in the application of patent 360,070, was shown in the patents to Boyden and Perkins. The claims of the application of patent 360,070 referred to were the original claims 1 and 2, rejected in the office letter of January 14, 1887.

406 X Q. Where did you find in said Perkins patent the subject-matter described in those two claims?

Same objection.

A. The terms of the first claim of the application of the patent No. 360,070 as originally filed, was rejected on the patent to Boyden, because Boyden's construction showed a triple valve provided with a device for admitting air directly from the main air pipe to the brake-cylinder. The claim referred to had no further limitation by which the reference to Boyden's patent could be avoided. While it was very clear that the operation of the device shown in patent 360,070 was very different from that shown in the patent 280,285 to Boyden, the terms of the claim described a construction which was shown in the Boyden patent, and Boyden's patent was given as a reference for the purpose of calling the attention of the attorney to the fact that this claim might be construed to cover a device such as that shown by Boyden. Substantially the same reasons applied in the case of the original second claim of patent No. 360,070. The patent to Perkins was not given as a reference, because the patent to Boyden was considered a better reference, and it is not customary to multiply references for the same claim, and it was not certain that the Perkins patent would operate in exactly the same way that the Boyden device did, but the Boyden patent had claims covering a construction similar to the Perkins patent, in which a passage led from the train-pipe to the auxiliary reservoir and opened into the space above the triple-valve piston, and this space communicated 435 with the brake-cylinder in the application of the brakes, the passage from the train-pipe to the auxiliary reservoir and the space above the triple-valve piston being controlled by a check-valve. It was the resemblance of the Perkins patent to the construction shown in the Boyden patent 280,285, in regard to that particular construction, which I think was then covered by claim 1 of the Boyden patent, the subject-matter of the claim 1 of the Boyden patent being shown in the patent to Perkins.

Answer objected to by complainants' counsel as irrelevant and immaterial, whatever objection the Patent Office may have had as to claims 1 and 2 of the application of the patent 360,070, as originally filed, having been waived and withdrawn by the acceptance and allowance of an amended claim in lieu of the original claim 1, and the acceptance and allowance of claim 2 as filed, without change or modification in any particular. The answer is further objected to as incompetent, in so far as it construes the claims of any of the patents referred to.

407 X Q. Do you find any provision, and if so what, in said Perkins patent, for admitting air directly from the train-pipe to the brake-cylinder?

A. No. While I don't remember exactly why the Perkins patent was not given, with the Boyden, as a reference, it was probably due to the fact that the Perkins patent, while it showed the one-way passage referred to in claim 1 of the Boyden patent 280,285, did not show a "device for admitting air directly from the main air pipe to the brake-cylinder."

The passages were substantially the same as those shown by Boyden, but the device shown by Perkins would probably not operate in that way.

408 X Q. Then there was nothing in the Perkins patent that anticipated the device or combination referred to in the original first claim of the application of Westinghouse for patent No. 436 360,070, which claim specified "a triple valve provided with a device for admitting air directly from the main air pipe to the brake-cylinder;" am I correct?

A. There was nothing in it, except its resemblance to the Boyden patent, which resemblance was found in the passages, which were substantially the same as those shown in the Boyden patent.

409 X Q. Referring to the passages of the Perkins patent, I understand that the feeding-in passage admitted air from the train-pipe side of the triple-valve piston to pass around to the space at the opposite end of the triple-valve piston, which space was in open communication with the auxiliary reservoir, so that the air admitted from the train-pipe charged the auxiliary reservoir, and also the space at the end of the triple-valve piston opposite to the train-pipe end of the piston; am I correct in this?

Objected to as irrelevant, immaterial and not proper cross-examination.

A. Yes, I think you are.

410 X Q. In that respect, what material difference was there between the triple-valve device of the Perkins patent and any other known "automatic" triple-valve device, for example, the triple-valve device of the Westinghouse patent No. 144,006, dated October 28, 1873?

Same objection.

A. So far as being exposed to the pressure of reservoir air on one

side and train-pipe air on the other side, the piston shown in patent 144,006 is arranged similarly to that shown in the Perkins patent.

411 X Q. The said Westinghouse patent 144,006 and the said Perkins patent are also substantially the same, in respect to the fact that the train-pipe air, in charging the reservoir, passes, through a proper port, to the space at the end of the triple-valve piston opposite to the train-pipe end of said piston, which space is in open

437 communication with the auxiliary reservoir, and is not in open communication with the brake-cylinder at the time when air is passing from the train-pipe to said space; are they not?

Same objection.

A. They are not substantially the same, because there is a difference in the arrangement of the port through which the air is fed from the train-pipe to the auxiliary reservoir, and also in the means for controlling that port, which, in the Perkins patent, is different from that shown in the Westinghouse patent 144,006.

412 X Q. They are substantially the same in regard to the function of admitting train-pipe air to the space at the opposite end of the triple-valve piston, and holding it there in open communication with the auxiliary reservoir, but not in open communication with the brake-cylinder, at the time while the air is entering said space from the train-pipe; are they not?

Same objection.

A. In that respect they are substantially the same.

413 X Q. The Westinghouse patent No. 144,006 shows a valve which is the equivalent for the check-valve for controlling the feeding-in passage; does it not?

Same objection.

A. Yes, it does.

414 X Q. Said Boyden patent No. 280,285 differs both from the Perkins and from the Westinghouse No. 144,006, in the fact that, with the Boyden device, the air can be charged directly from the train-pipe into the brake-cylinder, while, with the other two mentioned, the air cannot be charged directly from the train-pipe into the brake-cylinder; am I correct in this?

Same objection.

A. Yes, I think you are.

T. J. HOGAN.

438 Testimony of Mr. H. H. WESTINGHOUSE resumed:

(A. to Q. 392 continued:) The higher train-pipe pressure on the train-pipe side of the check-valve 26 (9), overcomes the force holding the check-valve 26 (9) to its seat, and air from the train-pipe passes directly into the brake-cylinder, through the port controlled by the auxiliary valve 22 (15).

Air at the same time flows from the auxiliary reservoir into the

brake-cylinder and when the united pressure is greater than the train-pipe pressure, the force that opened check-valve 26 (9) will be reversed, and the check-valve will become seated, thereby preventing the flow of air from the brake-cylinder into the train-pipe.

In the structure shown in patent 360,070, check-valve 49 is also normally held to its seat, when brakes are applied for a graduated application. When it is desired to make direct communication between the train-pipe and the brake-cylinder, for the purpose of admitting air directly from the train-pipe to the brake-cylinder, the opening of the valve 41, by a greater traverse of the piston than is required for plain triple-valve work, reverses the force operating to hold the check-valve 49 in a closed direction, and it is moved from its seat, and air passes directly from the train-pipe to the brake-cylinder.

The passage leading from the check-valve to the brake-cylinder is in direct communication with the brake cylinder, and there will always be the same pressure in this passage and the brake-cylinder. To accomplish the reversal of the force that holds the check-valve to its seat, it is necessary that a considerably less pressure shall be present in the brake-cylinder and the check-valve passage, when the valve 41 is opened and train-pipe pressure is admitted to the outer side of the check-valve 49, for, if the flow of pressure from the auxiliary reservoir to the brake-cylinder is not restricted, then, upon the opening of the valve 41, the train-pipe pressure
439 admitted by valve 41 would be unable to overcome the force that tends to hold the check-valve 49 in a closed position.

For this reason, as well as others already stated, the passages leading from the auxiliary reservoir to the brake-cylinder in the mechanism shown in patent 360,070, have been properly and necessarily restricted.

The function and operation of the closing of the check-valve 49, for the purpose of preventing the back flow of pressure from the brake-cylinder into the train-pipe, is the same in defendants' structures and that shown in patent 360,070.

From the foregoing explanation it will be seen that, in both defendants' device and that of patent 360,070, it is essential that the plain triple-valve work shall be performed by a portion of the stroke of the valve piston. It is necessary, for the purpose of opening direct communication between the train-pipe and the brake-cylinder, that the triple-valve piston shall make a greater traverse than is required for plain triple-valve work.

In both devices, it is essential that restricted passages shall be properly located between the auxiliary reservoir and the brake-cylinder, to enable the proper force to be created to cause the triple-valve piston to make its greater travel than is required for plain triple-valve work, so that direct communication can be had between the train-pipe and the brake-cylinder.

In both devices, it is also necessary that the passage or passages leading from the auxiliary reservoir to the brake-cylinder shall be properly restricted, so that the flow of air from the auxiliary reservoir to the brake-cylinder, prior to the opening of the direct com-

munication between the train-pipe and the brake-cylinder, shall not be sufficiently great to cause the pressure in the brake-cylinder to equal or approximate the pressure in the train-pipe, otherwise there can be no flow of air from the train-pipe to the brake-cylinder.

It is also essential, in all the structures referred to in the question, that the flow of pressure from the auxiliary reservoir to the brake-cylinder shall be restricted, so that the force tending
440 to hold the non-return check-valves to their seats may be reversed, permitting the valve to open and the air to flow directly from the train-pipe to the brake-cylinder.

In view of these considerations, I am of the opinion that the principle and mode of operation of the defendants' valves, and the structure shown in patent 360,070, are substantially identical. The structural differences in these devices require a different location of the same parts in each device, with respect to each other, but I do not consider that such different arrangements in any way affect the principle or mode of operation of these structures.

NOTE.—The enumeration of the questions here changes by reason of the interposition of the deposition of Mr. T. J. Hogan between the former and the latter portion of Mr. H. H. Westinghouse's answer to Q. 392.

415 Q. While you have, in your last preceding answer, not only positively stated that instead of there being a difference in principle or mode of operation between the defendants' devices and the device of patent 360,070, as alleged by Mr. Church, that the devices are in fact *identical* in principle and mode of operation, and have given your reasons for your statement, I think it may be desirable for the enlightenment of the court that you should consider separately the several alleged differences recited by Mr. Church, and I will therefore endeavor to state briefly what I understand his alleged differences to consist in, and ask you to consider them separately, as presented in this and other questions in this regard.

In the first place I understand Mr. Church to allege that the patentee, Mr. Westinghouse, contrived "an additional valve element" and compelled the triple valve to actuate this additional element to admit train-pipe air to the brake-cylinder, and that, on the other hand, Mr. Boyden compelled "the triple valve
441 itself" to admit train-pipe air to the brake-cylinder without the aid of any auxiliary-valve element.

How far, if at all, is this allegation of difference warranted by the facts?

A. The facts do not in any way support the claim of an alleged difference. The valve structure in patent 360,070 contains a valve device for opening communication from the train-pipe to the brake-cylinder and the operation of this valve device is not essential in the performance of triple-valve work of the kind performed prior to 1887. This valve device is indicated by the numeral 41 in patent 360,070.

In the defendants' structures there is provided a valve device for

opening direct communication between the train-pipe and the brake-cylinder, and this valvular device is also unessential for the performance of plain triple-valve work. This valve is indicated by the numeral 22 in the 1891 catalogue, and 15 in the 1889 catalogue.

In respect to this feature of construction, both structures have, in their organization, a valve device that is supplemental to the plain triple-valve portion of the structures.

416 Q. If the valve device 41 of patent 360,070 and the valve device 22 (15) of the defendants' structures, were suppressed, what effect would such suppression have upon the capability of the several structures to perform the work of a plain triple valve, a "triple valve proper," or work of the kind performed by triple valves as known prior to 1887, and secondly, what effect would such suppression have upon the capability of the several structures to perform quick-action or emergency work, or, in other words, to effect the direct admission of train-pipe air to the brake-cylinder in making an application of the brakes?

A. The suppression of the parts named would not affect the operation of the valve devices in question for the performance of work as done by triple valves prior to 1887. It would, however, 442 totally destroy their capacity for admitting air directly from the train-pipe to the brake-cylinder.

Adjourned to Wednesday, December 13, 1893, at 10.30 a. m.

NEW YORK, *December 13, 1893*—10.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of H. H. WESTINGHOUSE resumed:

417 Q. In support of his allegation in answer 12, to the effect that, in patent 360,070, the admission of train-pipe air to the brake-cylinder was effected by "an additional valve element," while, in the defendants' devices, it was effected by "the triple valve itself," Mr. Church pretends that Mr. Boyden, as "the inventor of the defendants' device," by separating the piston chamber from the valve chamber, and restricting the passage for air from the auxiliary reservoir to the valve chamber, introduced what Mr. Church terms "the new principle of momentary differential pressures."

To what extent, if at all, was such "principle," a *new* principle, at and prior to the date of application of either of the Boyden patents, and to what, if any, greater extent is such "principle," or the mechanical means by which it is practiced, embodied in defendants' devices than in the quick-action triple valve of patent 360,070?

A. It is evident that Mr. Church's lack of practical experience has caused him to fail to observe that the principle of momentary differential pressures is not new, and that it is not embodied for the first time in defendants' structures.

All practically operative triple valves, whether of the kind 443 used prior to 1887, or those subsequently devised, perform

their functions only when momentary differential pressures are created by the means of restricted passages.

The presence of restricted passages, for the purpose of creating momentary differential pressures, is required for the same purpose in the defendants' structures as in that shown in patent 360,070, and it does not exist in any different degree in any of these structures.

418 Q. Mr. Church further states, in answer 12, that "the device of Mr. Westinghouse acts on the mechanical principle of employing the triple valve piston to actuate a new and additional valve element to open the passage from the train-pipe to the brake-cylinder."

Assuming Mr. Church to be entirely correct in this statement, please state what kind or type of element is employed in defendants' structures "to open the passage from the train-pipe to the brake-cylinder;" what member is employed "to actuate" such element; and what, if any, difference of "mechanical principle" exists, either in the *opening* members or the *actuating* members, as between the defendants' devices and that of patent 360,070.

A. What Mr. Church describes as a new and additional valve element, is also found in the defendants' structures, and is indicated by the numeral 22 in the 1891 catalogue, and 15 in the 1889 catalogue.

No one of these additional valve elements performs any function when the devices are operated as a plain triple valve, and they all perform the same function of opening direct communication between the train-pipe and the brake-cylinder, when the piston of the triple valve makes a further travel than is required for plain triple-valve operation.

In all of these structures the triple-valve piston is the member that actuates the additional valve element, and they are all caused to operate by a travel of the triple-valve piston for a greater distance than is required in the operation of plain triple valves.

Absolutely no difference of mechanical principle exists in 444 the opening and actuating members of the defendants' structures, as compared with those of the device of patent 360,070.

419 Q. Mr. Church further says, in answer 12: "Mr. Westinghouse uses a new and auxiliary valve, not a part of the triple valve; Mr. Boyden utilizes the feed-valve of the old triple valve."

I understand Mr. Church to mean, defendants' check-valve 26 (9).

To what extent, if at all, would the utilization of said check-valve 26 (9) enable the defendants' devices to effect the admission of train-pipe air directly to the brake-cylinder, if the new and additional valve element 22 (15) of said defendants' devices was suppressed; and to what extent, if at all, would the use of "a new and auxiliary valve, not a part of the triple valve," in the device of patent 360,070, enable said device to effect the admission of train-pipe air directly to the brake-cylinder, if the check-valve 49 of said device was suppressed?

A. If the new and additional valve element was not present in the defendants' devices, there could be no direct admission of train-pipe air directly to the brake-cylinder, and the presence of the check-valve 26 (9) would have no effect in maintaining the capability of these structures for admitting train-pipe pressure directly to the brake-cylinder.

The use of a new and auxiliary valve, not a part of the triple valve, in the device of patent 360,070, would not effect the admission of air directly from the train-pipe to the brake-cylinder, if the check-valve 49 was suppressed.

420 Q. Mr. Church further states, in answer 12, that: "Mr. Westinghouse actuates his new valve by the impact of the triple-valve piston," but, by some inadvertence, Mr. Church has omitted to make a comparative statement of what actuates the new and additional valve element 22 (15) of defendants' devices.

Will you please state by what said new additional valve element 22 (15) of defendants' devices is actuated?

445 A. The new and additional valve element 22 (15) of defendants' devices is actuated by the impact of the triple-valve piston, when it travels a greater distance than is required for plain triple-valve work. In this respect the operation is identical with that of the device shown in patent 360,070.

421 Q. Mr. Church further states, in answer 12, that "Mr. Boyden actuates the old feed-valve, such as that of his 1883 patent [meaning, as I understand, defendants' check-valve 26 (9)], by the differential air pressure momentarily established in the triple-valve chamber."

Mr. Church has again inadvertently omitted to make a comparative statement of what actuates the check-valve 49 of the device in patent 360,070, and I will be glad if you will do so?

A. I understand Mr. Church's statement is to the effect that, by a reduction of pressure on the brake-cylinder side of the check-valve 26 (9), of defendants' structures, the higher pressure on the train-pipe side forces the check-valve open, and that this difference of pressure is brought about by means of restricted passages.

The mode of operation of the check-valve 49, in the device of patent 360,070, is practically the same. When train-pipe pressure is admitted to the train-pipe side of the check-valve 49, it forces the check-valve 49 open, because restricted passages, leading from the auxiliary reservoir to the brake-cylinder, prevent the flow of pressure to the brake-cylinder side of the check-valve, thereby permitting the higher train-pipe pressure to overcome the resistance of the lower brake-cylinder pressure.

422 Q. Mr. Church in answer 12, argues that because the suppression of the valve 41 and port 42, in the device of patent 360,070, and the suppression of the partition 9, in the Boyden device, in each case prevents quick action, *therefore* the parts named, in each case, respectively, "constitute the quick-action device as distinguished from the old triple valve."

446 Mr. Church has again inadvertently omitted to make a comparative statement as to the effect, on the one hand, of

the suppression of defendants' new and additional valve element 22 (15), relatively to the valve 41 and port 42 of patent 360,070, and, on the other hand, of the suppression of the partition and restricted passage between the auxiliary reservoir and brake-cylinder of patent 360,070, relatively to the partition 9 and restricted passage of defendants' devices.

Please make the comparison a complete and parallel one, and state the result?

A. The suppression of valve 22 (15), in the defendants' devices, and the suppression of valve 41, in the device shown in patent 360,070, which valves relatively perform the same function in all of these structures, would prevent quick action in each case, and these structures would then be only capable of performing plain triple-valve work.

The presence of the partition and restricted passage between the auxiliary reservoir and the brake-cylinder of the defendants' devices, is essential for the purpose of creating a sufficient difference of pressure, between the reservoir side and the train-pipe side of the triple-valve piston, to enable a sufficient stroke of the piston to be made to open valve 22 (15). It is also necessary that this partition and restricted passage should exist for the purpose of creating a reversal of force that holds the check-valve 26 (9) to its seat, so that it may be opened in a direction to permit air to flow from the train-pipe to the brake-cylinder. If this partition and restricted passage is removed, or if the restricted passage is not properly located and proportioned, with reference to ports controlled by valve 22 (15) and valve port 40, then the differential pressures required to move the triple-valve piston to its completed stroke, and to force the check-valve 26 (9) open, will not be created, and the function of quick action will not be performed.

In the device shown in patent 360,070, it is also essential that differential pressures shall be created between the train-pipe
447 side and the auxiliary reservoir side of the triple-valve piston, and this is obtained by the proper restriction of the passages leading from the auxiliary reservoir to the brake-cylinder. If the passages leading from the auxiliary reservoir to the brake-cylinder were not restricted, the flow of air from the auxiliary reservoir to the brake-cylinder would be so rapid as to render it impossible to lower the pressure on the train-pipe side of the triple-valve piston rapidly enough to create the differential pressures necessary to move the triple-valve piston to its completest stroke.

It is also necessary that the passage leading from the auxiliary reservoir to the brake-cylinder should be restricted, for, if this were not the case, the flow of pressure from the auxiliary reservoir to the brake-cylinder would be such as to admit an amount of pressure to the inner side of the check-valve 49, that would prevent the train-pipe pressure from overcoming and reversing the force holding the check-valve 49 to its seat, and, as it is essential for the passage of air from the train-pipe to the brake-cylinder, that this valve should be opened, the failure to provide a sufficient opening force would

cause the valve to remain seated, and prevent the flow of air directly from the train-pipe to the brake-cylinder.

It will therefore be seen that the suppression of restricted passages in all of the structures in question would, to the same degree and in the same manner, destroy their function, so far as relates to the admission of train-pipe air directly to the brake-cylinder.

423 Q. Please make another parallel suppression in the device of patent 360,070 and in the defendants' devices. That is to say, suppress, in each case, the full or further of the two traverses of the triple-valve piston, and state what would be the result in the operation of the devices, (1) as triple valves proper, performing the functions known prior to 1887, and (2) as appliances for effecting the direct admission of train-pipe air to the brake-cylinder.

A. In the devices referred to, if the traverse of the triple-
448 valve piston is restricted to a point where communication is first opened between the auxiliary reservoir and the brake-cylinder, they will perform all the functions of plain triple valves as used prior to 1887.

If the travel is so restricted, it will entirely destroy the capability of these structures to open direct communication between the train-pipe and the brake-cylinder.

424 Q. How far, if at all, do you find Mr. Boyden's statements on page 27 (D. R.) as to an alleged "fourth valve," and its supposed function, to be true and correct statements?

A. As I understand Mr. Boyden's statement, it is to the effect that the so-called fourth valve performs some function of the triple valve proper as used prior to 1887, and that its presence is essential to such operation.

With this understanding, I think his description and statement is entirely wrong.

The alleged fourth valve, which is controlled by port 35, is used when, and only when, the triple-valve piston is in position to establish direct communication from the train-pipe to the brake-cylinder by means of port 42, and such position is never used when the device is operated as a plain triple valve.

If his second statement is intended to mean that valve 22 performs some function, and is an essential part of the triple valve proper as used prior to 1887, or occupies the position shown in drawing 6, during the admission of air from the auxiliary reservoir to the brake-cylinder when operating as a plain triple valve, then I absolutely and entirely disagree with him.

425 Q. In drawing No. 5 of Defendants' Exhibit "Illustrative Cuts," which Mr. Boyden refers to in his statement as to patent 360,070, under the heading of fourth valve, the port 35 is shown as open, and air is indicated as passing through this port, from the
auxiliary reservoir to the brake-cylinder, by a red line. The

449 port controlled by the valve 41 is also shown as wide open, but there is no indication of the passage of air through such port.

Does or does not said drawing No. 5, correctly illustrate the traverse of the air in the device of patent 360,070, in practical op-

eration, when the parts are in the position shown in said drawing No. 5?

Objected to, as impliedly asserting the incorrectness of said drawing No. 5, whereas said drawing was made merely to illustrate the way in which the air moves from the auxiliary reservoir to the brake-cylinder, when the triple valve is in the position shown in said drawing, and in respect to all that it was intended and used to illustrate, it is entirely correct.

The foregoing objection of defendants' counsel objected to by counsel for complainants, as being wholly improper and incompetent, for the reason that it makes defendants' counsel a witness in this cause. Complainants' counsel submits to the court that the drawing having been offered in the condition in which it appears, whatever error or inaccuracy it embodies, if any, is open to correction only by the testimony of witnesses and not by the statements of counsel.

A. I think the effect of drawing No. 5 is misleading, as it does not correctly indicate the flow or traverse of air that takes place in practical operation, when the triple-valve piston is in the position indicated in the drawing. There should be a line showing that air is passing from the train-pipe through the port controlled by the valve 41.

426 Q. To what extent is your answer to Q. 424 applicable to the statement of defendants' witness Church in folios 680, 681, pp. 170, 171.

A. So much of it as relates to the valve device of patent 360,070 is applicable to Mr. Church's statement.

450 427 Q. In folios 110, 111, p. 28 (D. R.) Mr. Boyden recites "four valves," as forming the "triple valve," that is, the triple valve proper, in patent 360,070 and in defendants' quick-action triple valves. To what extent is such recital a true and correct one?

A. His recital is incorrect.

Port 35 in the device of patent 360,070, and valve 22 of defendants' device, are not essential to, and do not perform plain triple-valve functions.

428 Q. What, if any, plain triple valve, or triple valve proper, functions are in practice, performed, or are, in practice, required to be performed, in the device of patent 360,070, or in the defendants' quick-action triple-valve devices, by any valve or valve element, other than the first, second, and third enumerated by Mr. Boyden in folio 110, p. 28 (D. R.)?

A. None.

429 Q. Is, or is not, the statement of Mr. Boyden, in the first paragraph of folio 116, p. 29 (D. R.), that one of the four valves forming the triple valve proper, in the defendants' structures, admits the main-air-pipe air to the brake-cylinder simultaneously with the auxiliary reservoir air when producing quick action, a true and correct statement?

A. I regard his statement as incorrect, for the reason that the op-

eration of the triple valve proper, in the defendants' device, is performed by three valves. The fourth valve referred to is only necessary when it is required to establish direct communication between the train-pipe and the brake-cylinder.

430 Q. Mr. Boyden states on p. 30 (D. R.) that "This distinctly shows that the complainants' device uses two valves to perform the quick application of the brakes, one of which belongs to the *triple valve proper* while the other is an *auxiliary valve additional* to the triple-valve structure."

While I understand from your preceding testimony that you disagree with other statements of Mr. Boyden which seem to me to be substantially to the same effect as this one, I wish you
451 would state whether or not you find this specific statement to be a true and correct one?

A. The statement is incorrect, because the port 35 of the device of patent 360,070, forms no part of the triple valve proper.

431 Q. Is, or is not, the following statement made by Mr. Boyden, on pp. 20 and 21 (D. R.), as to the operation of defendants' quick-action triple valve, plate XI defendants' 1891 catalogue, a true and correct statement, to wit:

"To apply the brakes fully with the auxiliary reservoir pressure by the final movement of the piston, sufficient pressure is gradually exhausted from the main air pipe to move the piston its full stroke. This will unseat the main valve 22 and thereby establish full communication between the auxiliary reservoir and brake-cylinder, and apply the brakes with the full auxiliary reservoir pressure.

"The operations just described are those of the 'triple valve,' *per se*, and are such as are used in the art prior to 1887."

A. The statement of Mr. Boyden is incorrect, for the reason that the valve 22 cannot be lifted from its seat to admit auxiliary reservoir pressure to the brake-cylinder, to perform the operation of plain triple valves as used prior to 1887, without admitting pressure directly from the train-pipe to the brake-cylinder.

432 Q. To what extent is your last preceding answer applicable to the statement of Mr. Church as to defendants' 1889 device, in the paragraph on page 196 (D. R.) commencing "To apply the brakes with full power in the shortest possible time," etc., understanding said paragraph to be comprehended within the statement which he makes subsequently on same page, to wit: that "the operations described are generally the same as those performed by the 'triple valve proper'?"

452 A. It is entirely applicable.

433 Q. Is your statement in answer 431, as to the incapacity of the valve 22 of defendants' quick-action triple valve, plate XI defendants' 1891 catalogue, merely a statement of your opinion, or is it based upon any actual and practical tests made by you with said device of defendants?

A. It is based upon actual practical experiments with defendants' device.

434 Q. Have you witnessed a repetition, by Mr. Boyden, of his experiments with defendants' quick-action triple valve, plate XI

defendants' 1891 catalogue, recited in his deposition, and if so, where and where?

A. I have witnessed a repetition of the experiments in question by Mr. Boyden, at the works of the Boyden Brake Company, a Baltimore, on November 7, 1893.

435 Q. What, if any, results were developed, in the experiment which were repeated in your presence by Mr. Boyden, which were at variance with the experiments made by you as stated in your answer 433, or which tended to show any incorrectness in your statement in answer 431?

A. The results of the experiments which I witnessed in the work of the Boyden Brake Company, were substantially the same as those I had previously obtained in similar experiments, and did not affect the opinion I had previously formed, and which I have expressed with respect to the functions and capabilities of the valve 22.

436 Q. In X Q. 152, Mr. Boyden was referred to the description of the operation of the Westinghouse quick-action triple valve of patent 360,070, contained between lines 80, p. 3, and 51, p. 4, of the specification of said patent, and was asked if it was not the fact that the functions, and the *only* functions, of the valve mechanism, as recited in such description, are,

1st. To admit air from the main air pipe to the auxiliary reservoir.

453 2d. To admit air from the auxiliary reservoir to the brake-cylinder through the port controlled by the graduating valve 29.

3d. To exhaust air from the brake-cylinder to the atmosphere.

4th. To effect the admission of air directly from the main air pipe to the brake-cylinder, accompanied by a subsequent admission of auxiliary reservoir air through the port 35.

Mr. Boyden replied, "Yes, those are the functions set forth in the patent specification referred to."

Please state whether or not you agree with Mr. Boyden, and state also whether or not the quick-action triple valve of patent 360,070 performs, in practice, any function whatever other than those specified in the question.

A. I agree with Mr. Boyden, and the structure of patent 360,070 does not perform any other functions than those recited in the question.

437 Q. How many, and which, of the functions recited in the last preceding question were performed by triple valves such as were known in the art prior to 1887?

A. Only the first, second and third functions recited in the last preceding question were performed by triple valves prior to 1887.

438 Q. From your familiarity with the art in air brakes for railroads, please state when first, and by whom, a triple-valve device was produced having the capacity of performing the first, second and third functions recited in Q. 436, and having in addition thereto the capacity of effecting, when desired, the admission of air

directly from the main air pipe to the brake-cylinder in an application of the brakes?

Objected to as immaterial and irrelevant, for the reason that such function is not covered by the claims of the patent in suit, nor is the patent, broadly, a generic patent covering the principle or mode of operation employed in effecting such function.

454 A. The first structure of the kind that performs the operations described, is shown in the device of patent 360,070, and was invented by George Westinghouse, Jr.

Adjourned to Thursday, December 14, 1893, at 10.30 a. m.

NEW YORK, December 14, 1893—10.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of H. H. WESTINGHOUSE resumed:

439 Q. When first, if you know, was the structure which was invented by George Westinghouse, Jr., and is shown in patent 360,070 as stated in your last preceding answer, put into practical service?

A. It was in the latter part of 1886, or first part of 1887.

440 Q. From your practical knowledge of, and experience with, quick-action automatic air brakes, state briefly what are the functions, and the *only* functions, performed in practice by the defendants' quick-action triple valves shown in plate IX defendants' 1889 catalogue and plate XI defendants' 1891 catalogue?

A. The functions of these structures, and the *only* functions, are, *first*, the admission of air from the train-pipe to the auxiliary reservoir through the check-valve 26 (9), the port B (e) and the port A (b.)

Second, the admission of air from the auxiliary reservoir to the brake-cylinder, for the purpose of the application of brakes, performed by triple valves prior to 1887, by means of valve port *i* in 1891 device, and by valve 13 in the 1889 device, with a partial movement of the triple-valve piston.

Third, the release of air pressure from the brake-cylinder to the atmosphere.

455 *Fourth*, the admission of train-pipe pressure directly from the train-pipe to the brake-cylinder, combined with the admission of the auxiliary reservoir pressure, when the triple-valve piston travels a greater distance than is required for the performance of triple-valve work as done prior to 1887.

441 Q. How many, and which, of these functions, are, operatively and in results, in correspondence with the functions performed by triple valves such as were known in the art prior to 1887?

A. Three functions, the first, second and third enumerated in my above answer.

442 Q. What is the function, and the *only* function, in practical operation, of the valve 22 of defendants' quick-action triple valve,

plate XI defendants' 1891 catalogue, and the corresponding valve 15 of plate IX defendants' 1889 catalogue, and by what mechanical means or member is said valve actuated?

A. To open direct communication between the train-pipe and the brake-cylinder.

The valve referred to is actuated by the triple-valve piston, when it makes a traverse greater than is required for plain triple-valve work.

443 Q. In what, if any, particular, of function, means of actuation, or operative relation to the other members of the appliance which perform the first, second and third functions recited in your answer 440, does the valve 22 of defendants' 1891 quick-action triple valve, or the corresponding valve 15 of defendants' 1889 quick-action triple valve, differ from the valve 41 of the structure of patent 360,070?

A. It does not differ.

444 Q. To what extent, if at all, is the valve 22 (15) of defendants' devices a necessary, or a practically useful, member of said devices, for any purpose or function whatever, other than that of admitting air directly from the main air pipe to the brake-cylinder?

A. The presence of valve 22 (15) of defendants' structures, for any other purpose than the direct admission of train-pipe air to the brake-cylinder, is useless and unnecessary, and is an injury to the operation of these devices as plain triple valves.

445 Q. Referring you to X Qs. 230 and 232 to Mr. Boyden (D. R.), and his answers thereto, please state to what extent, if at all, you find his said answers to be in conformity with that portion of your last preceding answer which states that "the presence of valve 22 (15) of defendants' structures, for any other purpose than the direct admission of train-pipe air to the brake-cylinder is useless and unnecessary."

A. I find that the answers referred to are in substantial conformity with my statement that "the presence of valve 22 (15) of defendants' structures for any other purpose than the direct admission of train-pipe air to the brake-cylinder is useless and unnecessary."

446 Q. From your practical knowledge of, and experience with, automatic air brakes, state whether or not defendants' quick-action triple valves could be so operated in practical railroad service as to raise the valve 22 (15) from its seat, without affecting a quick-action application of the brakes, in and by such unseating of the valve.

A. In practical operation the valve 22 (15) cannot be lifted from its seat, to perform any operation of braking, other than the direct admission of train-pipe air to the brake-cylinder, until the brakes have been fully applied by auxiliary reservoir pressure. After the brakes are fully applied by auxiliary reservoir pressure, the further traverse of the triple-valve piston will cause valve 22 (15) to be lifted from its seat, but no additional braking effect will be produced by such opening.

447 Q. Please state whether the check-valve 26 (9) and the port controlled thereby, are of the normal dimensions required to serve

for the purpose of the passage of air from the train-pipe to the auxiliary reservoir, or to serve as what has been termed by defendants' witnesses a "feeding-in valve," or are of larger dimensions, and if the latter, state why, and state also what effect is produced, in practical service, by the use of a valve and port of larger
 457 dimensions than would be necessary for the purposes of the feeding-in valve.

A. The proportions of the valves referred to are enormously greater than the requirements of a feeding-in valve call for, being more than two hundred times the size used in a practically operative triple valve. And the apparent reason for the adoption of the proportions shown in defendants' structures, is for the purpose of enabling this check-valve to perform the functions of the non-return check-valve as shown in the device of patent 360,070.

If the valve referred to, and the feeding-in port, were made as shown in the drawings of defendants' devices, the structures would be practically inoperative in regular service.

As stated in a previous answer by me, the construction of all practically operative triple-valve devices requires the use of restricted passages for the purpose of creating momentary differential pressures.

In the defendants' devices, on account of the disproportionate size of the check-valve 26 (9) and the passage B (e), it would be found impossible in practice to create the necessary differential pressures on the opposite sides of the triple-valve piston to cause it to move in the direction to effect the opening of the passage leading from the brake cylinder to the atmosphere.

I have seen quick-action triple-valve structures made by the defendant corporation, in which the feeding-in passage is differently located, and is properly restricted, and this further confirms my view of the impracticable character of the structures shown in defendants' catalogues of 1889 and 1891. The use of a check-valve to control a feeding-in passage, has been found to be objectionable and unnecessary, in a practically operative triple valve, and, to the best of my knowledge, has never been used in any form of triple valve that is practically operative in general service. A restricted port, properly located, has been found to meet all of the requirements of a practically operative triple-valve device.

448 Q. To what extent, if at all, is a construction, such as is shown in patent 220,556, in which the port or passage leading from the auxiliary reservoir to the brake-cylinder has what I believe you have characterized as a double control, that is, that it may be either partially or entirely uncovered, essential in the operation of a triple valve proper as known prior to 1887?

A. It is not essential or desirable, in the construction of a triple valve for practical operation, to do the work performed by triple valves prior to 1887.

449 Q. As a matter of fact, do or do not the defendants' structures possess the capacity of producing the same effect, in a service application of the brakes, as is produced if the piston and valve H of

patent 220,556 are allowed to make the extreme traverse which the patent shows they are capable of making?

A. They do not.

450 Q. I understand the defendants' witnesses to maintain that the port 35 of the appliance of patent 360,070 through which, as you have stated, the auxiliary reservoir air passes to the brake-cylinders, when, and only when, a quick-action application of the brakes is being made, is a part of the triple valve proper as used prior to 1887, and also that said port 35, as a part of the triple valve proper, is essential to the device, in effecting a quick-action application.

Please state whether or not said port 35 could be eliminated from the structure, without interfering with the performance of the quick-action function, and illustrate, by a drawing, a form of said structure in which the port 35 is eliminated.

A. The port 35 can be eliminated without interfering with the function of quick action.

I produce a tracing prepared under my direction illustrating a modification in which port 35 is eliminated.

By making a cavity marked *x*, in the face of the slide-valve, and connecting this cavity with the port 31, all of the capabilities of this structure for performing plain triple-valve work, and for performing the function of quick action, would be substantially the same as the construction shown in the device of patent 360,070, having the port 35.

Counsel for complainants offers in evidence the tracing referred to by the witness, and the same is marked "Complainants' Exhibit Westinghouse Modification."

(Here follows diagram marked p. 458a.)

Defendants' counsel objects to the answer and to the exhibit offered in evidence, on the ground that, in the so-called "modification," the port 35 is not eliminated, except in the sense that that particular form of port is eliminated, and another form of port is manufactured as a substitute for it.

The foregoing objection objected to by counsel for complainants, as making defendants' counsel a witness.

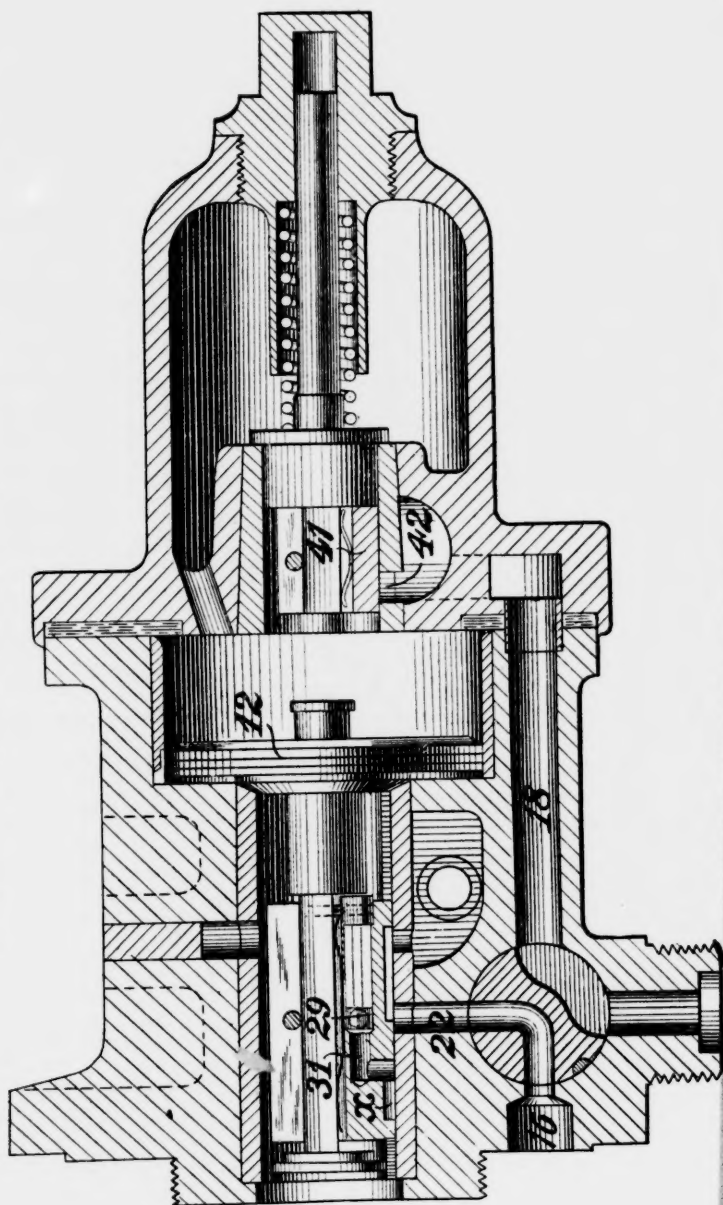
451 Q. In the modification shown in the tracing you have produced, what, if any, function is performed by the valve recess *x*, which communicates with the port 31 controlled by the graduating valve 29, in any operation whatever of the structure as a triple valve proper known prior to 1887?

A. None.

452 Q. It is stated in defendants' 1891 catalogue, page 29, referring to defendants' quick-action triple valve plate XI, that:

"The actions of this valve in graduating, full-service application, quick action and the release, are the same as the new Westinghouse quick-action valve, thereby producing the same results in braking,

Complainants' Exhibit "Westinghouse Modification."



which renders cars equipped with the two valves perfectly interchangeable—the hose coupling being the same.”

Assuming said statement to be true, what would be the necessary and inevitable operations of the defendants' device, when used on a car or cars of a train containing other cars equipped with the quick-action triple valve of patent 360,070?

Objected to as assuming that the quotation made from the defendants' 1891 catalogue is a comparison of the defendants' quick-action triple valve with the quick-action triple valve of the patent in suit, whereas, on the contrary, it is a comparison of the defendants' quick-action triple valve with the quick-action triple valves made by the complainants under patents to Mr. George Westinghouse, Jr., later in date than the patent in suit and for another and different construction.

Counsel for complainants submits that the defendants' catalogue, which has heretofore been offered as an exhibit, is the best evidence and that it is not proper or competent to attempt to explain or modify the subject-matter of said catalogue by the statements of counsel.

A. The necessary and inevitable operation of the defendants' device, when used under the conditions stated, would be the performance of plain triple-valve work by a portion of the traverse of the triple-valve piston, and the opening of direct communication between the auxiliary reservoir and the train-pipe, when a further traverse of the triple-valve piston is made for the purpose of causing a quick-action operation.

453 Q. Assuming the words “the new Westinghouse quick-action valve,” in the extract from defendants' catalogue made in Q. 452, mean a quick-action triple valve similar to that described and shown in any patent to Mr. George Westinghouse, Jr., later in date than the patent in suit which is within your knowledge, to what, if any, extent would your answer to Q. 452 be modified, under such assumption?

A. Not at all, so far as I now remember the constructions referred to.

1 454 Q. In his answer to R. D. Q. 238, Mr. Boyden states that in making a quick-action application of the brakes, with the appliance of patent 360,070, a greater amount of air pressure could be admitted to the brake-cylinder, through the port 35, than through the port 22 which is controlled by valve 41. Do you, or not, accord with this view?

A. Undoubtedly Mr. Boyden is in error with respect to this statement. In the operation described, a sufficient quantity of air passes through port 42 to produce a pressure of from thirty-five to thirty-eight pounds in the brake-cylinder, while, through port 35, a sufficient quantity passes into the brake-cylinder to produce a total pressure in the brake-cylinder of about sixty pounds. It is, therefore, clear that the greater amount of air, in making an emergency application, passes through the port 42.

455 Q. To what extent, if at all, do you agree with the view

expressed by Mr. Boyden in answer to R. D. Q. 239, as to the pressure exerted in the brake-cylinder by the air taken from the train-pipe, in making a quick-action application of the brakes by the appliance of patent 360,070?

A. I substantially agree with the statements made by Mr. Boyden, except that I have found, by experiment, that a higher pressure than twenty-five pounds is usually realized from train-pipe pressure in making a quick application.

456 Q. I understand the statements of Mr. Church, in folios 851 to 853, on page 213, and first paragraph of page 14 (D. R.), to the effect that the results produced by the valve 41 and port 42 of the appliance of patent 360,070, are produced in defendants' devices, directly by the triple valve proper, and that Mr. Boyden has succeeded in making a triple valve proper perform the operation of quick action without the addition of anything corresponding in name, construction, or mode of operation, with said valve 41 and port 42, to be in substance repeated and summarized in Mr. 462 Church's answer 12, which you have heretofore considered.

It may be, however, that I am in error as to this understanding, and I will therefore ask you to state whether or not the statements of Mr. Church referred to on pages 213 and 214 (D. R.) are true and correct statements.

A. They are entirely untrue and incorrect.

457 Q. To what extent do you find the comparative statements of the "valves or valve functions" in the structure of patent 360,070 and in defendants' structures, respectively, made by Mr. Church on page 214 (D. R.) to be a true and correct statement?

A. I think it correct in non-essential particulars, and untrue and incorrect in respect to the essential ones.

458 Q. Mr. Church states, on page 215 (D. R.), that in the device of patent 360,070, "it is requisite and necessary that the auxiliary valve should be moved by the piston to uncover a port for the admission of train-pipe air to the brake cylinder, whereas in defendants' structures there are no auxiliary valves," etc. To what extent is this statement a true and correct one?

A. The first part of it is true and correct, and the last part is untrue and incorrect.

459 Q. From your observation of a repetition of the experiments made by Mr. Boyden, as well as from those made by yourself, state whether or not you find the opinions and conclusions expressed by Mr. Church in his answer 13, commencing with folio 914, p. 229 (D. R.) as to the Boyden experiments, to be warranted or well founded?

A. It does not seem to me that they are either warranted or well founded.

460 Q. Please produce and explain a series of illustrations, on a large scale, prepared under your direction, for use at the hearing, of triple-valve devices such as you consider relevant and appropriate in elucidating questions of fact involved in this cause?

A. I produce the drawings asked for, being 27 sheets of 463 drawings, made to a large scale, so as to be used for exhibition

in court at the hearing, these drawings being respectively numbered and entitled as follows:

- No. 1, Jones pat. 166,386.
- 2, pat. 168,359 (release).
- 3, " (application).
- 4, 172,064 (release).
- 5, " (application).
- 6, 220,556 (release).
- 7, " (application).
- 8, Eng. pat. 3000 of 1879.
- 9, pl. B. 25, compl'ts' 1886 catalogue (release).
- 10, " " (application).
- 11, Boyden pat. 280,285 (release).
- 12, " " (application).
- 13, pat. 360,070 (release).
- 14, " (service app'n).
- 15, " (quick action).
- 16, " (quick action, showing check-valve).
- 17, def'ts' 1889 valve (release).
- 18, " (service application).
- 19, " (quick action).
- 20, def'ts' 1891 valve (release).
- 21, " (service app'n).
- 22, " (quick action).
- 23, the "triple valve proper" of Boyden's 1891 appliance (release).
- 24, ditto (application).
- 25, Boyden's 1891 quick-action device with Westinghouse "triple valve proper."
- 26, Boyden's 1891 quick-action device with modified differential passages and Westinghouse triple valve proper.
- 27, Boyden's 1891 quick-action device without passage "B," and with slide-valve of pat. 360,070.

464 Drawings 1 to 22 inclusive, are enlarged views, made in accordance with the drawings of the several patents and the plates of the defendants' catalogues referred to, including instances showing the parts in release, application, and quick-action positions, as marked on the different sheets. They are substantially the same in proportion and details as the small originals from which they are taken, although there may possibly be some minor errors in making the enlargements, as I have not yet had time to examine them critically.

The remaining sheets, Nos. 23 to 27 inclusive, I will now explain.

Drawing No. 23 illustrates the triple valve proper portion of the Boyden 1891 appliance, with the auxiliary valve 22 removed, and a fixed bushing substituted for it. This figure shows the structure in the release position.

Drawing No. 24 represents the same modification with the parts in position for the application of the brakes.

Drawing No. 25 represents the Boyden quick-action device with the Westinghouse triple valve proper.

Drawing No. 26 shows the Boyden 1891 quick-action device with modified differential passages and Westinghouse triple valve proper.

Drawing No. 27 represents Boyden's 1891 quick-action device without passage "B," and with slide-valve of patent 360,070.

Counsel for complainants offers in evidence the 27 sheets of drawings referred to by the witness, and they are marked by the examiner "Complainants' Exhibit Illustrations."

Defendants' counsel reserves the right to object to these said twenty-seven drawings, or any of them, for due cause, after he shall have had time to examine them and become familiar with them.

Adjourned to Friday, December 15, 1893, at 10. a. m.

465 NEW YORK, December 15, 1893—10 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of H. H. WESTINGHOUSE resumed.

Cross-examination *de bene esse* :

461 X Q. How long have you been in the employ of the Westinghouse Air Brake Company ?

A. Since the year 1872.

462 X Q. During that period, from 1872 to the present time, have you been familiar with the various triple-valve mechanisms put into use by said company ?

A. I have.

463 X Q. Have you also been familiar with the various patents on triple-valve mechanisms taken out by your brother, George Westinghouse, Jr. ?

A. Not to the extent that I have been familiar with the practical construction and operation of these devices.

464 X Q. Do you know what was the first patent that he took out on a triple-valve mechanism, if so, state what patent ?

Objected to, if intended to ask of the witness anything as to the scope of any patent taken out by Mr. Geo. Westinghouse, Jr., or as to what is covered by, or claimed in, any patent taken out by Mr. Westinghouse.

Defendants' counsel states that he does not propose to cross-examine the witness as to the scope of the claims of any patent, inasmuch as that matter was avoided in the direct examination.

Counsel for complainants replies that notwithstanding defendants' counsel's disclaimer of such intention, the language in the question "What was the first patent that he took out on ?"

466 would seem to clearly cover the enquiry as to what subject-matter was covered by, or claimed in, the patent. If defendants' counsel will limit his enquiry as to what patent first *illustrates* or *describes* a triple-valve mechanism, there can be no possible objection, and no room for doubt as to what is enquired about.

Defendants' counsel states that the witness may consider this question as modified according to the suggestion of complainants' counsel, and answer it with that understanding.

A. I am not now sufficiently familiar with the subject, to state which is the first patent he took out on triple-valve mechanism.

465 X Q. So far as you know, was not the patent of August 12, 1873, No. 141,685, the first of his patents which described or showed such a mechanism?

A. As before stated, I am not sufficiently well informed to answer with any degree of accuracy, but my impression is that this is not the first patent of Mr. George Westinghouse, Jr., which illustrates a triple valve, as I remember that one form of triple valve, and possibly more, was or were actually made before the one illustrated in patent No. 141,685 was constructed.

466 X Q. Did the device of patent No. 141,685 go into actual use on railways, and if so, to what extent, and how long was it continued in use before it was superseded by an improved form of triple valve?

A. A form of triple valve substantially in accordance with the illustration of patent 141,685 was experimentally used for some months on a passenger train, and, generally speaking, performed in a satisfactory manner.

467 X Q. By what was this form of triple valve superseded?

A. To the best of my recollection, the next form was one that embodied substantially the essential features of this valve, but a larger diaphragm was substituted for the purpose of operating the valve mechanisms, and I believe that metal was substituted for rubber in the construction of the diaphragm.

468 X Q. How long was the diaphragm used for actuating the triple valve, and when was it superseded by the piston?

A. So far as I can recollect, I should say that diaphragms were used about three years before the piston construction was adopted.

469 X Q. What was the first patent of Mr. George Westinghouse, Jr., which showed or described a triple valve with the piston substituted for the diaphragm?

A. So far as I now know, patent 144,006 is the first that shows a triple valve operated by a piston, but, as already stated, I am not sufficiently familiar with the patent question to absolutely state that this is the first triple valve that is patented having a piston to operate it.

470 X Q. Was the triple valve which is illustrated and described in patent No. 144,006 put into actual use on railways; if so, to what extent, and for how long a time before it became superseded by another and more improved form?

A. I believe it was used for a short time on a train in regular service, but I don't think it was in use, if at all, more than a few weeks. My information in respect to this matter is very indistinct.

472 X Q. Please refer to the patent granted to George Westinghouse, Jr., October 5, 1875, No. 168,359, and state whether the construction of triple valve therein described and shown was put into

actual practical use, and if so, to what extent it was used, and for how long a time before it was superseded by other and improved forms?

A. The triple valves substantially as shown in the patent referred to, were put into practical operative use to a considerable extent, and by reference to the date of the patent application, I should say that it was probably used for a period of about a year and a half or two years before any important modification was made in the triple-valve construction. During the time stated it is probable that it was the only form of triple valves furnished by the Westinghouse Air Brake Company in connection with automatic brake apparatus.

472 X Q. What form of triple valve superseded the triple valve of patent No. 168,359?

A. The form of triple valve having, at least, some of the modifications shown in patent 172,064.

473 X Q. To what extent was the form of triple valve shown in patent 172,064, dated January 11, 1876, put into practical use, and for how long a period did it remain in use before it was superseded by other and more improved forms?

A. I believe this form was adopted as standard about the first of the year 1876, and, with the exception of some valves similar to our previous standards, which were furnished to roads that were using the form shown in patent 168,359, it was generally used until some time during the year 1879.

474 X Q. What form of triple valves, in the year 1879, superseded the form shown in patent No. 172,064?

A. A form having the general features of improvement shown in patent No. 220,556.

475 X Q. To what extent did triple valves having the general features of the device shown in patent No. 220,556, go into practical use, and for how long a time did they remain in practical use before other important improvements were added?

A. They probably went into practical use some time during the year 1879, and were generally used on passenger trains, and locomotives and tenders, up to the year 1886. The particular construction was not found suitable for use on long trains, and another form was devised and used exclusively in connection with the brakes on freight trains. This latter form is illustrated in patent No. 243,415 to George Westinghouse, Jr., dated June 28, 1881. The form shown in patent 220,556 is still generally used on locomotives and tenders.

469 476 X Q. For passenger service, what form of triple valve, in 1886, superseded the form shown in patent No. 220,556?

A. I cannot say that the form of patent 220,556 was superseded at the date named, but, about that time, brakes were furnished for passenger cars, with quick-action triple valves substantially in accordance with the device of patent 360,070 in suit.

477 X Q. For how long, and to what extent, was the device shown in patent 360,070 actually used for passenger service?

A. I believe about three or four hundred of these valves were in

use for practical service, and they remained in use about two years.

478 X Q. On what railroad were they used?

A. On the Baltimore & Ohio railroad.

479 X Q. Were they then removed and another form of triple valve substituted; if so, what other form?

A. They were removed, and the form shown in patent 376,837 to George Westinghouse, Jr., dated January 24, 1888, which we had subsequently adopted as standard, was substituted.

480 X Q. To what extent, and for how long a period, was the form of triple valve shown in patent 376,837 used in service for passenger trains?

A. This form of valve has been used almost exclusively, since the date mentioned, up to the present time, for passenger trains.

That was our standard, which we furnished on all orders received, unless otherwise instructed. In a few instances, the form shown in patent 220,556 was specified and supplied, but the number furnished relatively to the kind shown in the patent 376,837 was very small.

481 X Q. What form of triple valve was first used by the Westinghouse Air Brake Company, to any considerable extent, on freight trains?

A. Substantially the form shown in patent 243,415 to George Westinghouse, Jr.

482 X Q. To what extent, and how long, was the form of triple valve shown in patent 243,415, used by said company for freight service, before it was superseded by some other form, and what other form superseded it, and when?

A. The form of valve shown in patent 243,415 was put into use about the year 1883, and about fifty thousand were furnished before it was superseded by other forms. So far as I am aware, all of these valves are still in operation, except such as have been put out of use by the ordinary wear and tear and deterioration of such devices.

In 1886 a valve similar in construction to the one shown in patent 360,070 was made and applied to the extent of about two or three thousand sets.

Valves made in accordance with the construction of patent 243,415, were furnished to some extent after 1886, and they are furnished, to a small extent, even at the present time, principally for the purpose of repairs to similar apparatus previously supplied.

483 X Q. What was the first quick-action triple valve that was adopted by the Westinghouse Air Brake Company, as their standard form of quick-action triple valve, and when was it adopted?

A. The form shown in patent 360,070, and it was adopted during the year 1886.

484 X Q. When was it superseded by the adoption of another standard form of quick-action triple valve, and what was the latter form?

A. It was superseded by one of the form shown in patent 376,837, in the latter part of 1886 or the early part of 1887.

485 X Q. In your answer to X Q. 482, you state that "in 1886 a valve similar in construction to the one shown in patent 360,070

was made and applied to the extent of about two or three thousand sets;" on what railroads were these valves applied?

A. On the Atchison, Topeka & Santa Fé R. R., the Union Pacific R. R., and the Northern Pacific R. R.

486 X Q. Are those two or three thousand sets still in use on those railroads; if not, by what were they superseded, and when?

471 A. So far as I am informed, they are still in use, as we have never substituted any other form for them.

487 X Q. Comparing the structures shown in patents No. 220,556 and No. 243,415, of Mr. George Westinghouse, Jr., what, if any material and substantial differences are there between the triple valve devices of said two structures, and why was the structure of patent 243,415 any better adapted to freight service than the structure of patent 220,556?

A. The general form shown in patent 243,415 is a much less expensive structure than the one shown in patent 220,556, and is capable of performing every operation of triple-valve work equally as well as the form shown in patent 220,556. The operative advantage of the valve of patent 243,415, as compared with that of patent 220,556, is due to the proportioning of the port that lead from the auxiliary reservoir to the brake-cylinder. The operation of valves constructed like those shown in patent 220,556, when used on a long train, has proved very objectionable, on account of the quicker application of the brakes on the front portion of the train than on the rear, on account of the size of the passage leading from the auxiliary reservoir to the brake-cylinder, that may be opened under some operations of this valve. This objectionable action was modified, to a considerable extent, in the device shown in patent 243,415, by a proper proportioning of the port leading from the auxiliary reservoir to the brake-cylinder.

If the larger opening of the port from the auxiliary reservoir to the brake-cylinder, for the purpose of getting a quicker application of the brakes under some circumstances, were desirable, it could be readily and more cheaply obtained in the structure of patent 243,415, without the necessity of resorting to the more expensive and less desirable method shown in patent 220,556.

Such proportioning of the passage in valve of patent 243,415 would not affect its capacity for performing all the function of a plain triple valve in the most perfect degree.

472

488 X Q. Why could the larger opening of the port from the auxiliary reservoir to the brake-cylinder, be readily and more cheaply obtained, in the structure of patent 243,415, than in that of patent 220,556?

A. My statement was to the effect that it could be more readily and cheaply obtained in patent 243,415 than it is obtained in the construction shown in patent 220,556. In the construction shown in patent 243,415, the only change required would be the making of a larger hole or passage leading from the auxiliary reservoir to the brake-cylinder, and the making of this larger hole could be as conveniently done and with as little cost as the smaller one. No other change would be required, to change the capacity for a different

degree of rapidity of the application of brakes under certain circumstances.

In the construction, as shown in patent 220,556, the opening of the larger port from the auxiliary reservoir to the brake-cylinder under certain circumstances, *requires* that the traverse of the triple-valve piston and its valves shall be considerably greater than is required to make the less rapid application of the brakes, and this requirement of further traverse increases the length of all the principal portions of this structure fully twenty-five per cent., and its construction is therefore objectionable, as compared with the one shown in patent 243,415, because of its greatly increased cost, and because its peculiar construction is absolutely without operative advantage, as compared with the structure shown in patent 243,415.

489 X Q. Why would not the enlargement of the passage leading from the auxiliary reservoir to the brake-cylinder, in patent 243,415, necessitate the enlargement of the traverse of the triple-valve piston and its valve, in that structure, just as you say would be the case in the structure of patent 220,556?

A. Because the lateral enlargement, or widening, of the
473 passages leading from the auxiliary reservoir to the brake-cylinder, in structure of patent 243,415, would increase the size of the passage from the auxiliary reservoir to the brake-cylinder, without the necessity of increasing the travel of the triple-valve piston.

490 X Q. Do you refer to the difference between the form of said passage, at that part of it which passes through the cock K, and are you comparing the form shown at k^1 , figure 2 of patent 243,415, where said passage is elongated in cross-section, with the form of said passage in patent 220,556, at that part of it which passes through the cock K, where it is marked k^1 , and which appears to be round in cross-section?

A. I do not refer to the passages mentioned. The meaning I intended to convey was this: Assuming that the port a^1 and C of patent 243,415 are round, (a fact which I know to be the case in actual construction) the lateral widening of these ports would necessarily make a larger opening leading from the auxiliary reservoir to the brake-cylinder without any increase of the travel of the triple-valve piston.

491 X Q. In patent 243,415, does the specification say anything about making the port C oblong or flattened, or does the drawing of said patent show the port C thus constructed?

A. The specification does not seem to refer to any particular form of construction of the port C, and I presume the ports are intended to be circular.

492 X Q. Was the triple valve of the Westinghouse patent No. 141,685, dated August 12, 1873, capable of graduating the pressure upon the brakes?

Objected to as immaterial.

A. I am not quite sure what is meant by the term "graduation."

493 X Q. Was said triple valve capable of applying the brakes

with less than their maximum pressure, and of adjusting the degree of pressure with which they could be applied?

474 A. Yes.

494 X Q. How did it perform the graduating operation, and how did it apply the brakes with full pressure?

A. By making different degrees of adjustment of train-pipe pressure.

495 X Q. Was the apparatus of patent 141,685 an automatic air-brake apparatus, in the sense in which that term has been generally used within the last twenty years or more?

A. It was the triple-valve portion of what is known as automatic-brake apparatus.

496 X Q. What is meant by the expression "automatic air brake," in the sense in which that term has been employed during the last twenty years or more?

A. I presume the term "automatic" relates more specifically to the capability that this brake possesses of applying, under some circumstances, without the aid of manual manipulation.

497 X Q. Under what circumstances does this automatic action take place?

A. Substantially any condition of circumstances in which train-pipe pressure is reduced below auxiliary reservoir pressure, to a degree that enables the triple valve to operate.

498 X Q. For example, does it take place in case the train should be broken in two and the train-pipe parted?

A. It usually does. In fact, it always does when the brake is in an operative condition.

499 X Q. Assume the triple valve of patent No. 141,685 to be used on a train, and the train to break in two, and state just how and by what movement the triple valve would act automatically to apply the brakes, and whether it would apply them with maximum force?

A. Under the conditions named, I presume the brakes would be applied with maximum force. By the separation of the train, all pressure would escape from the upper side of the diaphragm

475 *n*, and the pressure in the auxiliary reservoir acting on the under side of the diaphragm *n*, will force it in an upward direction, resulting first in the closure of the port *h*², leading from the brake-cylinder to the atmosphere, finally opening the valve *a*, thus permitting the stored pressure in the auxiliary reservoir to flow through port *o*, into the brake-cylinder, thereby applying the brakes with maximum force.

500 X Q. In the triple valve of patent 141,685, in this automatic operation by which the valve *a* is lifted from its seat, so as to allow auxiliary reservoir pressure to pass into the brake-cylinder and apply the brakes with maximum force, was this automatic unseating of valve *a*, one of the functions of the triple valve?

A. The unseating of valve *a* was one of the functions of the triple valve in the patent in question, but the unseating of the valve *a*, by the reduction of pressure made by the separation of the train, was the same function, whether the valve was unseated by a reduc-

tion in the train-pipe pressure made in the way described, or in any other way. That is to say, the triple valve in question had no capability of operation that could not as well be performed by the manipulation of the engineer's valve, as by the reduction of train-pipe pressure made by the separation of the train or the bursting of the train-pipe.

501 X Q. Was it intended that the triple valve of patent 141,685, in case of the rupture or separation of the train-pipe, should unseat the valve *a*, and admit the reservoir pressure to charge the brake-cylinder with maximum force?

A. Beyond doubt it was, as no obvious means seem to have been provided to keep the valve from performing this function.

502 X Q. In that apparatus, then, one of the triple-valve functions was the unseating of valve *a* and thereby the application of the brakes with maximum pressure, in case of accidental rupture of the train-pipe, was it not?

476 A. The valve in question did not contain a function of the

kind stated, in distinction with any other opening of the valve *a* made for the purpose of a full application of the brakes.

503 X Q. Question repeated.

A. I can make no better answer to the question than the former.

504 X Q. I did not ask you whether said function was "a function of the kind stated, in distinction with any other opening of the valve *a*," but whether it was not one of the triple-valve functions, in that structure, to unseat and open its port for the admission of maximum pressure to the brake-cylinder, in case of the accidental rupture of the train-pipe; please answer this question responsively.

A. It is one of the functions of the valve *a* to open and admit air of maximum pressure to the brake-cylinder, in case of the accidental rupture of the train-pipe, or from any other cause that will sufficiently reduce train-pipe pressure to cause the valve *a* to be opened, and remain opened until the maximum pressure is charged into the brake-cylinder.

All that part of the above answer from and after the words "or from any other cause" objected to by defendants' counsel as not responsive, but volunteered and argumentative.

505 X Q. Will you please answer my questions responsively, reserving your arguments until they are called for. The function of the valve *a*, in opening to admit maximum air pressure into the brake-cylinder, in case of the accidental rupture of the train-pipe, was, in that structure, one of the triple-valve functions of the structure, was it not?

So much of the question as requests the witness to reserve arguments in reply until they are called for, is objected to by counsel for complainants, in view of the manifestly argumentative character of the question.

477 A. I do not wish to be understood as denying that the valve *a* will open, and charge auxiliary reservoir pressure into the brake-cylinder to a maximum degree, if a rupture in the train-pipe produces a sufficient reduction of pressure to cause such operation. Such operation is a normal one under the conditions stated, but I do not wish to be understood as admitting, or believing, that the operation described is a different mode of operation, so far as the movement of the valve *a* is concerned, as compared with the operation made by a similar reduction of pressure brought about by any other cause. I also do not wish to be understood as admitting or believing that the opening of valve *a*, under the conditions stated, is a function or operation performed only under the circumstances and conditions stated.

506 X Q. Answer objected to as not responsive and question repeated.

Objected to as already answered.

A. It is impossible for me to answer this question more responsively in view of the way it is stated.

507 X Q. The valve *a* is a part of the triple valve in patent 141,685, is it not?

A. It is.

508 X Q. It performs the function of opening to admit maximum pressure to the brake-cylinder in case of the accidental rupture of the train-pipe, does it not?

A. It does.

509 X Q. If it is a part of the triple valve, and performs the function stated, is not that function, thus performed by a part of the triple valve in that structure, a triple-valve function?

A. The triple valve in question will operate in the manner described under the conditions stated, but I am not prepared to describe the operation, under the conditions stated, as a function of a triple valve.

478 510 X Q. Do you wish the court to understand you as *denying* that it is a function of a triple valve?

A. I wish to be understood as believing that the opening of the valve *a*, is, in itself, a function of the triple valve proper, and that I do not regard the coupling of this operation with some peculiar or particular kind of reduction of train-pipe pressure, or of a reduction made in some particular way, as a proper description of a triple-valve function.

511 X Q. In your answer to X Q. 505, you state that such operation is a normal one under the conditions stated. In your answer to X Q. 501 you stated that it was an intended operation under the conditions stated. In your answer to X Q. 507 you stated that the valve *a*, which performs this operation, is a part of the triple valve. Now I want to know whether or not this normal and intended operation or function of the valve *a*, under the conditions stated, is a triple-valve function, or is a function of something else and not of the triple valve; please answer this question responsively.

A. I think the operation stated is properly described as a function

of admitting air from the auxiliary reservoir to the train-pipe through the port opened by valve *a*, such opening being caused by a reduction of train-pipe pressure brought about by the rupture of the train-pipe.

I have endeavored to answer this question, and all other questions relating to it, responsively, and have stated the facts of operation correctly, and my understanding of how I regard these operations. I do not see that I can add anything more to make myself clear.

Answer objected to by defendants' counsel as not responsive.

512 X Q. Is that function of opening valve *a* and admitting full pressure to the brake-cylinder, in case of the rupture of the train-pipe, a function performed by the triple valve, or a function performed by something else?

479 A. If the opening of valve *a*, and admitting maximum train-pipe pressure, is a function, then it seems to me it is performed by the rupture of the train-pipe and the operation of the triple valve.

513 X Q. Then, if it is performed by the operation of the triple valve, under the conditions stated, and is, as you have testified, a normal and intended operation of the triple valve, under the conditions stated, it is a triple-valve function, is it not?

Objected to as argumentative and misleading and simply intended to commit the witness to the endorsement of some particular view held by defendants' counsel, as to the meaning or application of the term "triple-valve function."

Defendants' counsel objects to the objection, as instructing the witness how to further evade the question, and states that said function either is or is not a function of the triple valve, and he proposes to find out, from this witness, whether it is the function of a triple valve or the function of something else.

Counsel for complainants deems it only just to himself to ask the attention of the court to the fact that the record shows that he has given the witness no instruction whatever.

A. I do not think the term "triple-valve function" properly describes the operation in question.

514 X Q. What do you understand the meaning of the word "function," when applied to mechanical structures, to be?

A. To the best of my knowledge at present, the best description I can give of the sense in which I have used the word "function," is to substitute the word "capability," which is the nearest comparative word I can now think of.

515 X Q. The "capability" of the structure of patent 141,685 to admit full pressure to the brake-cylinder, upon the accidental
480 rupture of the train-pipe, is a "capability" of the triple valve shown in that patent, is it not?

A. The triple valve in question has the capability of operating as described when the rupture of the train-pipe makes a sufficient reduction of train-pipe pressure. If this operation is to be described

as a capability, I think it should be stated as a capability of the valve to operate as described, when the train-pipe is ruptured.

516 X Q. The triple valve of patent 141,685 has such a mode of action that when the train-pipe is ruptured, the triple valve acts to admit, automatically, full pressure to the brake-cylinder; is not this a fact?

A. It operates, under the conditions named, in the same manner that it operates when any considerable reduction of pressure is made in the train-pipe. I do not know that I have ever thought of or described the operation of the triple valve under this circumstances as "automatic."

517 X Q. That function of the triple valve is performed automatically, under the conditions stated, is it not?

A. I think that the whole operation, under the conditions described, would generally be considered an automatic operation, as compared with a similar application produced by the use of the engineer's valve or conductor's valve.

518 X Q. Why have the Westinghouse air brakes been termed "automatic air brakes" for the last twenty years or more?

A. I should presume this term was applied to them, principally on account of the application of the brakes in the event of the parting of the train or the bursting of the train-pipe, or from any other cause that would produce a considerable reduction of pressure in the train-pipe, besides the usual methods of operating the brakes by the engineer or trainmen.

Adjourned to Saturday, December 16, 1893, at 10 a. m.

481

NEW YORK, *December 16, 1893*—10 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of H. H. WESTINGHOUSE resumed:

519 X Q. In the structure of patent 141,685, was any provision made, and if so, what, for enabling the brakes to be applied by the engineer with graduated pressure?

A. The construction shown in patent 141,685 provides for the admission of air pressure from the auxiliary reservoir to the brake-cylinder, in the various degrees less than the maximum.

That is to say, if it is desired to admit a small or limited amount of pressure to the brake-cylinder, this valve has the capacity to act in this manner, as well as to admit maximum pressure.

This regulation of the flow of air from the auxiliary reservoir to the brake-cylinder is accomplished, in this structure, by making a smaller reduction of pressure in the train-pipe than is required for a maximum application of the brakes. Assuming a pressure of seventy pounds in the train-pipe and auxiliary reservoir, and that it is desired to make an application of the brakes with moderate pressure, if pressure in the train-pipe is reduced five pounds, for instance, the pressure in the train-pipe will be sixty-five pounds, while

that in the auxiliary reservoir is still seventy pounds. The higher auxiliary reservoir pressure on the under side of the diaphragm *n*, will move it in an upward direction, which movement will cause valve *a* to be opened, thereby permitting air to flow from the auxiliary reservoir to the brake cylinder, through the ports *o* and *II*¹.

Air will continue to flow into the brake-cylinder until the pressure in the auxiliary reservoir is reduced to a little less than sixty-five pounds. As this pressure is a little less than the pressure on the upper or train-pipe side of the diaphragm *n*, the diaphragm 482 will be forced in a downward direction, causing valve *a* to be closed, thereby preventing any further increase of pressure in the brake-cylinder.

The foregoing described operation is the method by which this structure charges a limited amount of air pressure into the brake-cylinder.

520 X Q. Attached to the valve *a*, in the device of that patent, is a tapering extension or plug *o*; what is the object of that tapering plug, and what function does it perform in the structure?

A. The object of the piece in question is to form a guide or support for the pin *s*¹, and that is the function it performs.

521 X Q. The specification of that patent states as follows:

"The conical plug *o* is attached to the lower end of the stem *g* in such position as to enter the port *o*¹, which connects the chambers *G*¹ and *II*; but this plug *o* is of such shape as to graduate the size of the opening of the port *o*¹, accordingly as it is raised more or less by the upward movement of the stem *g*.

* * * * *

"By the use of the taper plug *o*, in the manner described and by regulating, as can easily be done by the use of suitable cocks, the amount of pressure in the upper and lower parts of the chamber *G*¹, it is easy to regulate the amount or density of the air which is permitted to flow through the port *o*¹ into the brake-cylinder, and consequently easy to regulate and adjust, at all times, the force with which the brakes are applied, and such force may be varied from the maximum power of the brakes down to the fractional part of a pound, in excess of ordinary atmospheric pressure."

This description describes the plug *o*, as the means by which the graduating function is performed, does it not?

483 A. No.

522 X Q. What does it describe, as you understand it?

A. It describes a construction of valve with the plug attachment, the plug being of such shape or form that the size of the port in which it is inserted will be varied as the valve is lifted a greater or less distance from its seat. It then states that

"By the use of the taper plug in the manner described and by regulating, as can easily be done by the use of suitable cocks the amount of pressure in the upper and lower part of the chamber *G*¹, it is easy to regulate the amount or density of the air which is permitted to flow through the port *o* into the brake-cylinder and consequently easy to regulate and adjust at all times, the force with which the

brakes are applied, and such force may be varied from the maximum power of the brakes down to the fractional part of a pound in excess of ordinary atmospheric pressure."

The only possible construction to be placed upon the matter quoted from the specification is, that by the use of the combination of the plug *o*, as shown in the patent, and by the regulation of pressures by means of suitable cocks, the amount or density of the air which is permitted to flow into the brake-cylinder is regulated.

As a matter of practical operation of the structure shown in the patent in question, the use of plug *o* for the purpose described in the parts of the specification which have been quoted, is entirely unnecessary.

523 X Q. In the matter above quoted by you, what do you understand by the expression "suitable cocks;" does that refer to the cock or valve generally known as the engineers' valve?

A. I presume it does.

524 X Q. As described in said patent 141,685, do the diaphragm *n* and valve *a*, have different degrees of upward movement, according as it may be intended by the engineer to apply the brakes with less or greater force?

A. I think the substance of some portions of the specification is to the general effect that, by a manipulation of the engineers' valve in a suitable manner, the diaphragm *n* and valve *a* could be moved a greater or less distance, for the purpose of admitting different degrees of pressure to the brake-cylinder.

525 X Q. Assuming that structure to be used on a train, and assuming the train-pipe to be accidentally ruptured, so as to release its pressure and apply the brakes automatically, would the diaphragm *n*, valve *a*, and plug *o*, move upward to the extreme limit of their movement in that direction?

A. They probably would.

526 X Q. And would such movement of said parts to the extreme limit in the upward direction open the port *o'* more fully than a shorter upward movement of said parts, for example, such an upward movement as would take place in admitting five pounds of air pressure from the auxiliary reservoir to the brake-cylinder, as stated by you in answer to X Q. 519?

A. Such upward movement of said parts would probably open the port *o'* more fully than a shorter movement, but such complete upward movement is frequently made, and can be readily made, when charging a limited amount of pressure into the brake-cylinder, as described by me in a former answer.

527 X Q. Is there any necessity for giving said parts their extreme upward movement in the act of attempting to apply the graduated pressure to the brakes?

A. It is frequently the most desirable mode of operation, and it is the necessary method for the purpose of stopping the train quickly by a graduated application of the brakes.

528 X Q. If I understand you, then, a skillful engineer, using the apparatus of patent 141,685, would, in case of a sudden emergency

485 requiring the application of the brakes with their full force, in the shortest possible time, suddenly exhaust the train-pipe pressure, to such an extent as to force the diaphragm *n*, valve *a*, and tapering plug *o*, upward to the full extent of their movement in that direction, and thereby open the port *o*¹ to its full capacity; am I correct?

A. Yes.

529 X Q. Referring now to the patent of George Westinghouse, Jr., dated October 5, 1875, No. 168,359, please explain briefly the operation of the apparatus therein shown, in the act of making a graduated application of the brakes.

A. Assuming that the train pipe and auxiliary reservoir are charged with pressure of seventy pounds, and the triple-valve piston G and slide-valve H are in the position shown in figure 1, if it is desired to make a graduated application of the brakes, a reduction of pressure is made on the train-pipe side of the triple-valve piston G, such reduction being less than is required for a full application of the brakes. The higher auxiliary reservoir pressure will force the piston G in a downward direction, carrying with it valve H, until the end of valve H uncovers port *c*. Air will then flow directly from the auxiliary reservoir to the brake-cylinder.

In its downward movement for a sufficient distance to uncover port *c*, the piston G strikes the stem *d*⁴ a little before the valve H uncovers port *c*, and thereafter, during the continuance of its stroke, it overcomes the resistance of the spring *d*². With the port *c* uncovered, the passage of air from the auxiliary reservoir to the brake-cylinder will reduce the pressure on the upper side of the piston G, until the combined effect of the higher train-pipe pressure and the compressed spring *d*² forces the valve H to the position where port *c* is entirely covered. Communication from the auxiliary reservoir to the brake-cylinder will be cut off, and a pressure less than the maximum pressure will have been charged into the brake-cylinder and retained there.

486 530 X Q. Explain briefly the operation of the same apparatus in making a full application of the brakes in the shortest possible time, as in case of an emergency.

A. The operation asked about is substantially the same as the one already described, except in respect to the amount of reduction of pressure in the train-pipe.

To make a full application of the brakes, it is necessary that the pressure on the under side of piston G shall be reduced sufficiently below the fully expanded auxiliary reservoir pressure, when it has passed into the brake-cylinder for a full application, to force the piston G in its complete downward position, and to overcome the resistance of spring *d*².

531 X Q. In that apparatus, when the piston G is forced downward to the full extent of its movement in that direction, its V-shaped projection *v* rests upon the rubber seat *v*¹, does it not?

A. Yes.

532 X Q. In making a full application of the brakes in the shortest possible time, as in the case of an emergency, with that appa-

ratus, the piston G is forced downward until it rests against the rubber v^1 , is it not?

A. It generally is.

533 X Q. And that full movement of the piston G causes the valve H to open the port e wide open, does it not?

A. Yes, it does.

534 X Q. In making a graduating application with that apparatus, for example, in admitting ten pounds of air pressure into the brake-cylinder, how far would a skillful engineer ordinarily move the piston G downward, and to what extent would such movement uncover the port e ?

A. If he desired to operate the brakes to the best advantage, he would manipulate the engineers' valve so as to produce a full movement of the piston G, and open the port e to its greatest extent.

487 535 X Q. In case he did do that, how many pounds pressure would he get in the brake-cylinder?

A. The amount of pressure charged into the brake-cylinder would depend entirely upon the length of time that the port e remained open.

The structure shown in patent 168,359 can be manipulated so as to open port e to its full capacity, and charge into the brake-cylinder the smallest amount of pressure required in a practical operation of brakes.

536 X Q. In the ordinary application of that apparatus by skilled engineers, for graduating purposes, where it was desired to apply the brakes slowly, with a light pressure, how was the apparatus operated? Was it operated to move the piston to its *full* stroke, so as to fully uncover the port e , or was it operated to move the piston a *partial* stroke, so as to only partially uncover the port e ?

A. To apply the brakes both moderately and slowly, it is desirable to operate the triple valve in question so as to partially uncover the port e .

537 X Q. And to apply them quickly, with full force, it is desirable to operate the triple valve of that structure so as to fully uncover the port e , is it not?

A. To make a full application of the brakes, it is desirable that port e shall be fully and quickly uncovered.

538 X Q. That apparatus, then, was so organized, that, to apply the brakes slowly and moderately, the piston would ordinarily be moved through a portion of its full stroke, and partially uncover the port e , while to apply them quickly, with full force, the piston would be moved the entire length of its stroke, and fully uncover the port e : am I correct?

A. A single structure of this kind in use on a train would operate in the manner described, if it were desired to apply the brakes slowly and moderately in one instance, and with a full application in another.

When, however, structures of this kind are regularly used in practice, on trains of from five to fifteen cars, their operation is
488 somewhat different, as compared with the operation of a similar structure when used on a single car.

The maximum flow of pressure, and the rapidity with which brakes can be applied with full pressure, is dependent upon two conditions. The first condition is, that reduction of pressure in the train-pipe, and on the under side of piston G shall be rapidly made so that the piston G will quickly move to a position to allow air to flow from the auxiliary reservoir to the brake-cylinder.

The second condition is, that the passage leading from the auxiliary reservoir to the brake-cylinder should be large enough to permit the rapid flow of pressure from the auxiliary reservoir to the brake-cylinder, when such port is open.

If the reduction of train-pipe pressure is not rapidly and considerably made, then the travel of the triple-valve piston G will be sluggish, and the operation of the brakes correspondingly slow.

If, on the other hand, the communication between the auxiliary reservoir and the brake-cylinder is too much restricted, the passage of air into the brake-cylinder will be retarded, although the reduction of train-pipe pressure may have been great and rapid enough to have quickly opened such passage.

It will therefore be seen, that the arrangement and proportions of the relative parts of an automatic brake mechanism should be such that the passage leading from the auxiliary reservoir to the brake-cylinder should be of a size to permit the flow of air, from the auxiliary reservoir to the brake-cylinder, at a rate that will cause a fall of pressure in the auxiliary reservoir that is practically the same as the rate of reduction made in the train-pipe. If the passage leading from the auxiliary reservoir to the brake-cylinder were of a size that, when fully uncovered or opened, it would cause a reduction of pressure in the auxiliary reservoir more rapidly than it is possible to reduce pressure in the train-pipe, and train-pipe side of the triple valve, then such proportioning of the passage would be ob-

489 viously unnecessary, as only so much of the passage leading from the auxiliary reservoir to the brake-cylinder would be uncovered by the valve controlling such passage, as would be required to lower the pressure in the auxiliary reservoir, and on the upper side of the triple-valve piston, at the same rate that it is lowered on the under side, or train-pipe side, of the valve piston. For, if the passage leading from the auxiliary reservoir to the brake-cylinder should be opened wide enough to cause a greater reduction of pressure on the upper side of the triple-valve piston than is being made on the lower side, the higher pressure on the lower side would at once move the piston and valve in an upward direction, until the flow of pressure from the auxiliary reservoir to the brake-cylinder would be at a rate to practically establish an equilibrium of forces acting on the opposite sides of the triple-valve piston.

If, on the other hand, the passage from the auxiliary reservoir is too greatly restricted, with reference to the reduction of pressure on the train-pipe side of the triple-valve piston, then the complete and quick traverse of the piston, brought about by the rate of reduction of train-pipe pressure, will be less effective, in the quick and full application of the brakes, than would have been the case if the passage from the auxiliary reservoir were proportioned with respect to

the rate or fall of pressure on the train-pipe side of the triple-valve piston.

From the foregoing explanation, it will be seen that to secure a uniform and simultaneous application of automatic brakes, on a train of cars fitted with the triple-valve structure of patent 168,559, it is essential that the reduction of pressure shall be made in the triple valve, at the same rate and at the same time; for the purpose of obtaining the results stated, these requirements are absolute, with the use of the construction in question.

In the practical operation of automatic brakes, the general mode of causing them to apply, is for the engineer to manipulate a valve on the engine which opens communication between the train-pipe and the atmosphere. This opening causes a reduction of pressure in the train-pipe, which is made more rapidly at a point nearer to the valve operated by the engineer than it is in more remote parts of the train-pipe extending to the rear of the train. At the rear of the train, the reduction is at the slowest rate, and commences at the latest period after the opening of the engineers' valve. This method of application, as before stated, was the one generally used in applying automatic brakes. They would also be brought into action, and caused to apply, if the train-pipe were in any way ruptured or separated, so as to cause a considerable fall of pressure, and it was the general practice to place a valve in each car, that could be opened for the purpose of operating brakes, so far as their application was concerned, substantially in the same manner as by the use of the engineers' valve.

The length of time required to make the reduce of pressure in the train-pipe, when the reduction was made by the use of the engineers' valve, depended upon the length of the train, and some idea of the length of this time can be gathered from information obtained at the time of the Burlington brake trials, in which a train fitted with plain automatic triple valves was operated.

It was found that a period of thirteen seconds elapsed, after the opening of the train-pipe valve by the engineer, before any sensible reduction of pressure in the train-pipe took place in the fiftieth car. It was also found that, at a speed of twenty miles an hour, many of the brakes, on the rear portion of the train, did not commence to apply until the train had been entirely stopped by the application of brakes in the front portion of the train, brought about by the fact that these brakes were located relatively nearer to the point of greatest reduction in the train-pipe pressure.

The report of the Master Car Builders' committee stated, in substance, that a train of fifty cars, fitted with the automatic brake apparatus in use at those trials, was stopped as quickly when but thirty of the brakes were in operation, the remaining twenty (on the rear portion of the train) being cut out of service. This was an obvious result, as no useful effect is produced by applying brakes to the train after motion has ceased.

It is therefore evident that one of the necessary conditions of prompt and uniform application of brakes on trains of more than one car, viz., a reduction of triple-valve pressure at the same time,

on all of the cars of the train, was not obtained to any practical extent by the reduction of train-pipe pressure at a single point in the train-pipe.

It was also found that the rate of reduction in pressure, in triple valves located in different portions of the train, was not the same, differing in about the same degree as the times of reductions of pressure differed.

The effect of the manner of operating these brakes was extremely objectionable, being dangerous to life and destructive to property, and the Master Car Builders' committee did not think it practical or safe to operate the train to carry out the intended experiments, with the apparatus as then organized. This objectionable and dangerous operation was the result of the application of brakes more rapidly and with greater force, on the front portion of the train, than on the rear portion, before the stopping of the train was entirely completed.

The more rapid application of the several brakes of the train, with respect to each other, brought about by the more rapid flow of pressure from the auxiliary reservoir in some instances than in others, was caused by the fact that the more rapid rate of reduction in the front portion of the train-pipe, as compared with the rear portion, caused the port leading from the auxiliary reservoir to the brake-cylinder to be opened to a greater extent in the triple valves in which the reduction of train-pipe pressure was more rapid, and

492 this action greatly aggravated the objectionable results due to the difference in times of application of the several brakes, with respect to each other, as the brakes in the front portion of the train were not only applied more promptly than those in the rear portion, but the brake force was admitted to the brake-cylinder more rapidly, on account of the larger opening for the passage of air pressure from the auxiliary reservoir to the brake-cylinder.

The objectionable feature of the more rapid flow of auxiliary reservoir pressure to the brake-cylinder, in the triple valves nearest the point of the greatest reduction of pressure in the train-pipe, could have been, in a measure, corrected by a proportioning of the passages leading from the auxiliary reservoir to the brake-cylinder, in such a manner that this passage, in the triple valves nearest the point of discharge of train-pipe air, would be comparatively small, even with a full traverse of the triple-valve piston, and each succeeding valve towards the rear of the train would require the proportioning of the passage leading from the auxiliary reservoir to the brake-cylinder, differing somewhat from every other valve, and dependent upon its location in the train, with respect to the point of greatest reduction of the train-pipe pressure in making an application of the brakes.

Such proportioning is obviously impracticable, on account of the necessary change of position of cars in trains, with relation to each other and to the point of application of brakes.

Another modification in the proportioning of the passage leading from the auxiliary reservoir to the brake-cylinder could have been made, that would have caused the operation of the brakes to have

been less dangerous and objectionable, in respect to the producing of shocks or internal collisions.

This modification would have been such a reduction in the size of the passage leading from the auxiliary reservoir to the brake-cylinder as would have caused the auxiliary reservoir pressure to pass to the brake-cylinder very slowly. This would have
493 resulted in an application of the brakes, so moderate as to have made the retardation of the front portion of the train but little greater than the rear portion, thus removing the cause of the dangerous and objectionable operation before referred to.

This modification, however, would also have resulted in defeating the principal object for which power brakes are put upon trains, namely, to stop them in a less distance than is required by hand brakes to do the same work.

A careful consideration of the facts I have stated will make it clear that the practical conditions of operation required that the proportions of the passages leading from the auxiliary reservoir to the brake cylinder should be of a size that will, in operation, result in the maximum of train-stopping effect, with a degree of shock or internal collision that does not exceed the reasonable capacity that car structures have for sustaining such shocks and strains, without undue cost of repairs and maintenance.

Referring to the structure of patent 168,359, it will be seen that the port *e* leading from the auxiliary reservoir to the brake-cylinder is of considerable size, and if triple valves of this kind were used in an automatic brake mechanism, on a train of several cars, under no probable conditions could all of them, or in fact any great number of them, in a train, say of twenty cars, be made to operate so as to cause the piston G to make its complete traverse, and fully open the port or passage *e*, before full auxiliary reservoir pressure had been charged into the brake-cylinder.

If train-pipe pressure is completely exhausted, or lowered a little below the expanded auxiliary reservoir pressure, the piston will ultimately complete its traverse, but such triple valves as are at all remote from the point of application will not make such complete traverse until the auxiliary reservoir pressure has been fully charged into the brake-cylinder.

In practical operation, the valve of structure of patent
494 168,359 would be entirely unsuitable for use on any but comparatively short trains, closely coupled, so that there would be but little lost motion between the several cars of the train.

Referring to patent 243,415 it will be observed that the passage of the triple-valve structure, leading from the auxiliary reservoir to the brake-cylinder is much smaller, relatively, than the same passage in triple valve of patent 168,359. The triple valves used in the Burlington tests referred to were substantially the same as that of patent 243,415, and the result of those experiments proves conclusively that the size of the passage in question was greater than could be safely used when these valves were used upon long trains.

Referring to that portion of the question which speaks of the

method of operating brakes "slowly and moderately," I am of the opinion that the attempt to operate the brakes in the manner described would not be very successfully accomplished, for the reason, that if a slow and moderate reduction of train-pipe pressure was made, the outflow of auxiliary reservoir air to the passage *s* would be such as to prevent the effecting of a sufficient difference of pressure between the auxiliary reservoir side and the train-pipe side of the triple-valve piston to overcome the friction of the slide-valve H.

In practice, it has been found necessary to make a considerable and quick reduction of pressure, in the first instance, for the purpose of definitely effecting the closure of port *s*, by the downward movement of the triple-valve piston *e*.

The above long and discursive answer, occupying the greater part of the day's session, is objected to by defendants' counsel, as irresponsible to the question.

539 X Q. You have testified that the triple valve of patent 168,359 was used for about two years, before it was superseded by
495 another form of triple valve; was it used on passenger trains or freight trains?

A. Passenger trains.

540 X Q. What is the ordinary average number of cars employed in making up passenger trains?

A. I presume the average passenger trains consist of about eight cars, although, in some instances, as high as twelve or fifteen are regularly put on.

541 X Q. Is it your opinion that when Mr. George Westinghouse, Jr., in the specification of patent 168,359, directed the engineer to reduce the train-pipe pressure about fifteen pounds, in order to apply the brakes with full force, and to reduce the train-pipe pressure to a correspondingly less amount, in order to apply the brakes with less than the maximum power, he did not understand the operation of his own invention?

Objected to as incompetent.

A. I cannot quite see that the instructions quoted give sufficient information on which to base an opinion.

542 X Q. In what year were the Burlington trials to which you referred in your answer to X Q. 538?

A. In the year 1885.

543 X Q. Was the apparatus of patent No. 168,359 an automatic air-brake apparatus—that is to say, would it automatically apply the brakes with full pressure, as a consequence of the accidental rupture of the train-pipe?

A. Yes, it would apply under the conditions stated.

544 X Q. In thus automatically applying the brakes, on a passenger train of fifteen cars, and in consequence of the breaking apart of the train-pipe, would it move the piston G the full length of its stroke and open the port *e* wide open?

A. As stated in a previous answer, such operation would pre-

496 sumably always move the piston to its complete traverse and fully open the port *e*, but, as also stated, such complete opening would, or would not, take place prior to the complete equalization of auxiliary reservoir and brake-cylinder pressures, depending upon the location of the triple valve in question, with respect to the point at which the pressure is discharged from the train-pipe. If full auxiliary reservoir pressure has been charged into the brake-cylinder by the partial traverse of the piston *G*, resulting in the partial opening of the port *e*, the further and complete traverse of the piston *G*, and the full opening of port *e*, will accomplish no practical results in the matter of the application of brakes.

While it is not stated at what point in a train of fifteen cars the supposed rupture of the train-pipe takes place, I will assume that it is practically in the middle of the train. Upon this assumption nearly all of the triple valves in the train would operate in a manner that would cause a full opening of the port *e*, before auxiliary reservoir air has been fully charged into the brake-cylinder.

In practical experiments, I have found that a train of seven cars is the greatest length of train in which a port of the size of the port *e* leading from the auxiliary reservoir to the brake-cylinder can be fully opened, before full auxiliary reservoir pressure has been charged into the brake-cylinder. Generally speaking, therefore, it may be stated that if a rupture of the train-pipe should take place at some other point than near the middle of the train, the triple valves on the rear portion of the train, having the greatest number of cars with an unbroken train-pipe, will not fully open the passage *e* until full auxiliary reservoir pressure has been charged into the brake-cylinder.

545 X Q. While that triple valve of patent 168,359 was in actual use on passenger trains during the two years referred to, do you remember of hearing any complaints about its causing the damaging or destructive shocks or internal collisions to which you have referred?

497 A. There were a great many complaints about damaging shocks, but as these triple valves were not used upon long trains, the complaints were not based upon such serious results as those that were produced at Burlington to which I have heretofore referred.

Adjourned to Monday, December 18, 1893, at 10 a. m.

NEW YORK, *December 18, 1893*—10 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of H. H. WESTINGHOUSE resumed:

546 X Q. The triple valve of patent 168,359 was entirely practical for passenger trains, was it not?

A. It was considered so at the time it was used, that being the best appliance of the kind in the art.

547 X Q. So far as you know, it never seriously damaged or injured any of the passenger cars by reason of the shock, did it?

A. Not that I am aware of, although, owing to its peculiar construction, very objectionable results were produced in the matter of discomfort to passengers, when the trains were of any considerable length.

548 X Q. Referring now to the patent of George Westinghouse, Jr., No. 172,064, dated January 11, 1876, please state in what, if any, material respect, the structure there shown differed from that of patent 168,359, and what advance in the art was first found in patent 172,064?

A. Referring to the construction shown in patent 168,359, it will be observed, that the slide-valve H is attached to the stem of the piston G, in a manner that requires the valve to be moved whenever the piston G moves. That is to say, the piston G practically has no movement independent of the slide-valve H.

498 It will also be seen, in the illustration referred to, that when the parts of the triple valve are in the position shown, the port s, for admitting air from the train-pipe to the auxiliary reservoir, is opened by the complete upward traverse of the piston G.

To cause the triple-valve piston G to move in a downward direction for the purpose of applying brakes, it is necessary that the pressure on the lower or train-pipe side of piston G should be reduced below the pressure on the upper or auxiliary reservoir side of the piston G, and the amount of this reduction should be sufficiently great to overcome the friction of the piston G and slide-valve H.

On account of the considerable degree of friction in slide-valve H, a considerably greater reduction of pressure, relatively, was required to move the piston and slide-valve H combined, than to move the piston alone.

The failure of the engineer to make a proper reduction to overcome the resistance of the slide-valve and piston would result in the failure to close port s by the downward movement of the piston G, and such operation would not apply the brakes, and would also lower the pressure in the auxiliary reservoir without performing useful work.

Referring to patent 172,064, it will be seen that the principal structural difference, as compared with the device of patent 168,359, is a limited amount of independent movement of the triple-valve piston relative to the slide-valve.

This free movement of the triple-valve piston is of a degree that enables it to move downward, a sufficient distance to close the port connecting the train-pipe side of the triple-valve piston with the auxiliary reservoir side.

The amount of reduction of pressure on the train-pipe side of the triple-valve piston necessary to cause the piston to move and close the charging port is only that required to overcome the friction of the triple-valve piston alone, while, as already explained, in 499 the device of patent 168,359 a reduction of pressure great enough to overcome the resistance of the slide-valve and triple-valve piston combined was required.

By this improvement, the possibility of depleting the auxiliary reservoir, without applying the brakes, was greatly reduced.

549 X Q. Except in respect to the "lost motion" permitted by the construction shown in patent 172,064, the triple valve of the latter patent operated substantially the same as the triple valve of patent 168,359, did it not?

A. Except in respect to the said lost motion, and the result produced thereby, it did.

550 X Q. Briefly explain why it is that, in triple valves, the slide-valve corresponding to valve H of patents 168,359 and 172,064, is subjected to considerable friction during the movement of the piston G?

A. The friction of the valves referred to is principally caused by the absence of any but atmospheric pressure in the exhaust cavity, while there is usually a pressure of from fifty to seventy pounds on the back or the inner side of the valve. This pressure forces the surfaces of the slide-valve and the triple-valve casing in contact with each other with considerable force, and produces the friction referred to.

551 X Q. Please explain the material difference between the triple valve of patent 220,556 and the triple valve of patent 172,064, and state what substantial advance in the art was first shown in the triple valve of patent 220,556.

A. In the triple valve of patent 172,064, as previously explained, to cause the piston in the slide-valve to move in a downward direction for the purpose of opening communication between the auxiliary reservoir and the brake-cylinder, it was necessary to produce a sufficient difference of pressure between the train-pipe side of the piston and the auxiliary reservoir side to overcome the resistance of the friction of the piston and the slide-valve. The amount of this friction was considerable, and the difference of pressure on
500 the opposite sides of the triple-valve piston was proportionate to the resistance.

The principal objectionable result of the condition stated, existed in making graduated applications of the brakes, which may be explained somewhat as follows:

If a reduction of pressure of ten pounds were made on the train-pipe side of the triple-valve piston, and it required a reduction of two pounds to overcome the friction of the piston and slide-valve, the ten pounds reduction would then be sufficient to overcome this resistance, and move the triple-valve piston and slide-valve so that pressure would be admitted from the auxiliary reservoir to the brake-cylinder.

As the friction of the slide-valve and piston are practically the same when in position for admitting pressure from the auxiliary reservoir to the brake-cylinder, and as it is necessary that the pressure on the auxiliary reservoir side of the triple-valve piston should be lowered sufficiently to enable the pressure on the train-pipe side to move the piston and slide-valve to a position that will cut off communication between the auxiliary reservoir and the brake-cylinder, it is evident that the cutting off of this communication

will not take place until a difference of pressure on the opposite sides of the piston of two pounds is produced by the flow of pressure from the auxiliary reservoir to the brake-cylinder, because it has already been assumed that this difference of pressure is required to overcome the frictional resistance of the piston and slide-valve, whenever it is desired to move them.

The result of this operation is, that instead of charging ten pounds of auxiliary-reservoir air into the brake-cylinder, twelve pounds would have entered, before communication between the auxiliary reservoir and brake-cylinder has been cut off.

Described in general terms, the effect of this friction is to prevent the admission of auxiliary-reservoir pressure to the brake-cylinder, in the limited quantities found to be desirable in the practical operation of triple valves.

501 Referring to the construction of patent 220,556, it will be noted that, combined with the slide-valve II, there is a supplementary valve e^1 , which controls a port marked s^1 .

The movement of valve e^1 is the same in extent, and is brought about by the independent motion of the triple-valve piston, as compared with the slide-valve II. Assuming the structure to be in the position shown in figure 1 of the patent in question, a reduction of pressure on the train-pipe side of the triple-valve piston will cause the piston to move in a downward direction, carrying with it the valve e^1 , by means of pin e^2 , thus moving it from its seat c , but such movement will effect no result, in the application of brakes, until the port s^1 registers with the port C.

Assuming that the reduction made on the train-pipe side of the triple-valve piston, for the purpose of an application of the brakes with a limited pressure, and assuming, as in the previous instance, a reduction of ten pounds in the train-pipe, auxiliary reservoir pressure will flow into the brake-cylinder, through the port s , until the difference of pressure between the auxiliary reservoir and the train-pipe side of the triple-valve piston shall be such that the higher pressure on the train-pipe side of the piston will move it in an upward direction until valve e^1 is seated, and communication cut off between the auxiliary reservoir and the brake-cylinder.

The construction shown in patent 220,556 requires, for the purpose of cutting off communication between the auxiliary reservoir and the brake-cylinder, that the differences of pressure on the opposite sides of the triple-valve piston shall be only such as to overcome the resistance of the triple-valve piston alone, the valve e^1 having practically no frictional or other resistance.

The principal improvement in this structure, as compared with the one shown in patent 172,064, is its capacity for charging
502 limited amounts of pressure into the brake-cylinder, for making graduated applications of the brakes.

552 X Q. The amount or degree of reduction of train-pipe pressure requisite to move the slide-valve II, so as to cut off communication between the brake-cylinder and the atmosphere, preliminarily to the introduction of auxiliary reservoir pressure into the brake-cylind-

der, is substantially the same with the triple valves of all three of said patents, Nos. 168,359, 172,064 and 220,556, is it not?

A. Assuming that the relative proportions of the various parts and passages are the same, my answer is yes.

553 X Q. But, with the triple valves of patent 220,556, after the admission of auxiliary reservoir pressure into the brake-cylinder once begins, it will be stopped earlier than with the triple valves of patents 168,359, 172,064, because it requires a less diminution of pressure on the auxiliary reservoir side of the piston G, to move such piston G upward, and seat the valve *c'*, in the structure of patent 220,556, than it requires, in the structures of the said other two patents, to move both the piston G and the slide-valve H upward, to close communication between the auxiliary reservoir and the brake-cylinder; am I correct?

A. Assuming that the graduated application is made through the port *s'*, I believe your statement is correct.

554 X Q. In the structure of patent 220,556, the port *s'* is the port through which the graduated application of the brakes was intended to be made, is it not?

A. I should suppose it was, as it is the best adapted for that purpose.

555 X Q. There is a port *s''* shown in figures 1, 4 of the drawings of patent 220,556; has that port been generally retained and used, in the triple valves made by the Westinghouse Air Brake Company since the date of that patent?

A. It has not.

556 X Q. Assuming the triple valve of patent 220,556 to
503 be used on a train of cars, and assuming that, by the rupture or parting of the train-pipe, a sudden and considerable reduction of train-pipe air pressure takes place, state what movement of the piston G and slide-valve H would thereby be effected?

A. Assuming a train of fifteen cars, as in a previous answer, and assuming that the rupture of the train-pipe was near the middle of the train, the operation of the valves on the train, if of the kind shown in patent 220,556, will be somewhat as follows:

The first two or three valves in each portion of the train nearest the rupture in the train-pipe, would have a complete triple-valve piston movement, causing the slide-valve H to move to its lowest position, thus fully uncovering port C.

The succeeding valves of the train would probably stop at a point where the port *s'* would open communication between the auxiliary reservoir and the brake-cylinder, and remain in that position for a longer or shorter period, dependent upon their location with reference to the rupture in the train-pipe.

Under all of the conditions stated, it is probable that the pistons of all of these triple valves would move to the position of complete opening of port C, before all of the auxiliary reservoir pressure was charged into the brake-cylinder through the port *s'*, but the amount of pressure charged into the brake-cylinder, by the full opening of port C, would rapidly decrease towards the end of the train, and I should say that all but from five to ten pounds would have been

admitted to the brake-cylinder before the port C is fully uncovered by the complete downward movement of the triple-valve piston.

With a greater number of cars, the mode of action described is such as to cause the additional size of the port C, as compared with the port *s*¹, to produce no practical effect in more quickly charging auxiliary reservoir pressure into the brake-cylinder.

It may also be stated, that in general practice, there is usually nothing requiring the full and more prompt application of brakes, by the rupture of the train-pipe, than under many other conditions, the principal requirement, under such conditions, being that (if the rupture of the train-pipe is caused by a separation of the train) both parts of the train shall be stopped without again coming together or uniting with destructive effect.

557 X Q. In your last answer you state "that in general practice there is usually nothing requiring the full and more prompt application of brakes, by the rupture of the train-pipe, than under any other conditions;" state what "other conditions" you refer to.

A. Under the conditions of impending disaster in the form of collisions, open draw-bridges, and other defects of the track or obstructions upon the track, or any other condition in which the distance that can be run without encountering accidents, is limited, it is of the highest importance that the brakes should be applied as quickly as possible. The conditions under which the rupture of train-pipes usually take place are such as to make the most important consideration the one previously stated, as there is usually no other circumstances connected with the accident of train-pipe rupture to call for an unusually quick application of the brakes.

558 X Q. In the last part of your answer you refer to the necessity of preventing the two separated portions of the train from coming together in collision, do you?

A. I do, yes.

559 X Q. The conditions of impending disaster or extreme danger referred to in the first part of your answer to X Q. 557 are the conditions to which the name "emergency" is usually applied, are they not?

A. I should say they would be correctly described as emergency conditions.

560 X Q. Does the triple valve of patent 220,556 belong to the class of so-called "automatic" air brakes?

A. It is a part of an automatic air-brake system.

561 X Q. The feature of employing a slide-valve, which was introduced by the use of the slide-valve II in patent 168,359, has been adhered to by the Westinghouse Air Brake Company in the construction of its triple valves ever since the date of that patent, has it not?

A. In general practice it has; experimentally other kinds of valves have been used.

562 X Q. The feature of giving said slide-valve a lost motion or giving the piston a lost motion with respect to the slide-valve, first introduced in patent 172,064, has been retained and employed by

the Westinghouse Air Brake Company, in substantially all of its triple valves, ever since the date of the patent 172,064, has it not?

A. It has.

563 X Q. The feature of employing the small auxiliary valve or plug valve marked *e*¹ in patent 220,556, in addition to the slide-valve, has been retained and employed by said company, in substantially all of its triple valves made since the date of patent 220,556, has it not?

A. It has.

564 X Q. You have heretofore testified that, during the latter part of 1886 or the early part of 1887, the form of triple valve shown in patent 360,070 was, for the purposes of freight-car service, superseded by the form of triple valve shown in patent 376,837; how long did the last-mentioned form of triple valve remain the standard form of the Westinghouse Air Brake Company?

A. It has remained the standard up to the present time.

565 X Q. Assuming a train of six or eight passenger cars, equipped with the triple valves of patent 220,556 to be running swiftly on the railroad, when suddenly the engineer discovers an open bridge, two or three hundred feet ahead of the engine; how would it be his duty to apply the brake apparatus in such case, and, when so applied, what would be the movement of the triple-valve pistons and valve H?

566 A. Under the conditions specified, the engineer would open the application valve to its greatest extent, and release the train-pipe pressure as rapidly as possible, which would probably result in the complete traverse of the triple-valve pistons of the triple valves in the front portion of the train, which would fully open the port C, while the pistons of the triple valves of the cars on the rear portion of the train would first move to a position that would bring the port *s*¹ into communication with the port C, admitting auxiliary reservoir pressure to the brake-cylinder through the port *s*¹. If the accident of running into the draw-bridge, which would probably take place under the conditions named, did not interfere with the further operation of the triple-valve structures, the pistons of all the triple valves would finally make their complete traverse, and fully open the port C, although, upon the cars of the rear portion of the train, the larger part of the braking would have been done by the admission of auxiliary reservoir pressure through the port *s*¹.

567 X Q. In the operation of a triple valve like that shown in patent 220,556, at the normal air pressure with which such air-brake apparatus is usually charged, how much more rapidly would the air pressure flow from the auxiliary reservoir into the brake-cylinder when the triple valve was so operated as to suddenly open the passage C wide open, than would be the case when the triple valve was so operated as to put only the port *s*¹ into communication with the passage C?

A. I cannot definitely state what the difference in time would be, but, assuming one port to be fully opened in one instance, and the other to be fully opened in another, I should suppose the difference

in time required to charge full auxiliary reservoir pressure into the brake-cylinder would be less than one second.

567 X Q. The rapidity with which, under the several conditions stated, the air would flow from the auxiliary reservoir to the brake-cylinder, through said ports C, s^1 , respectively, would be in direct proportion to the cross-sectional areas of the two passages C, s^1 , would it not?

567 A. I do not know whether the times of application, when made through the two different-sized passages, would bear the same relation to each other as the areas of their cross-section, as I have never made a practical experiment directly in the line that would enable me to be accurately informed on that point.

568 X Q. That does not quite answer my question, which related to the comparative rapidity of the flow through said ports respectively, that is to say, to the comparative amounts of air that would flow through them in any given time, rather than to the question of the time in which the brakes would be applied. With this understanding, please answer the question again.

A. I do not know whether the rapidity of flow through the passages in question, and under the conditions that they are used, would be in direct proportion to their cross-section. This was substantially the meaning I intended to convey in my previous answer.

569 X Q. Is it true that air under pressure, in traversing a passage, is obstructed by sharp turns or right angles in such passage, so as to flow less freely or rapidly through the passage than it would flow if the passage were straight?

A. It depends largely upon the rate of flow.

570 X Q. Do you mean that it depends largely upon the pressure under which the flow takes place—I ask this question because the "rate of flow" is the very thing I am trying to get at. In answering this question again, as thus explained, you may assume that the passage is charged to its full capacity.

A. Under the conditions, as I understand them to be stated, the presence of angles or sharp bends interferes with the flow of air.

571 X Q. In the triple valves of patent 220,556, auxiliary reservoir air, passing to the brake-cylinder through the graduating passage e^2 , e , s^1 , C, would have to turn its course at right angles twice during its passage, namely, first, in passing from e^2 to e , and, secondly, in passing from e to s^1 , would it not?

A. Such portion of the air as enters by port e^2 would have the course described in the question.

508 572 X Q. In case the piston G were moved through its entire traverse, so as to open the passage C wide open, the auxiliary reservoir air would pass directly from the port R to the port C, without being obliged to turn any corners or right angles, would it not?

A. It would.

573 X Q. Do you remember what was the length of the full traverse of the triple-valve piston G, in the triple valves made by the Westinghouse Company under patent 220,556?

A. I do not remember what its travel was, but I should think it was about one and an eighth inches.

574 X Q. Answer the same question as to the length of the traverse of the triple-valve piston 12, in the triple valves made by the Westinghouse Company under and in accordance with patent No. 360,070?

A. I should think the total travel of the piston of the device of patent 360,070 is about one inch.

575 X Q. Do you know what the total length of traverse of the triple-valve piston is in the defendants' triple valves such as are shown in plate IX (1889 catalogue) and plate XI (1891 catalogue)?

A. I do not.

576 X Q. How long have you been familiar with the invention disclosed in patent 360,070?

A. I first knew of it a few months after its invention in 1886, and have known of it ever since.

577 X Q. In drawing No. 5 of Defendants' Exhibit Illustrative Cuts, does not the red line correctly show how the air moves from the auxiliary reservoir to the brake-cylinder, when the triple valve is in the position there illustrated?

A. It does.

578 X Q. In the experiments referred to by you in your answer to Q. 435, did you at any time lift the valve 22 (15) from its seat, without admitting the direct flow of air from the train-pipe to the brake-cylinder?

A. In none of the experiments that I conducted was I able to operate the defendants' valves to admit auxiliary reservoir air to the brake-cylinder, through valve 22 (15), without also admitting train-pipe pressure. After full auxiliary reservoir pressure was charged into the brake-cylinder, the further traverse of the triple-valve piston lifted valve 22 (15) from its seat, but as full auxiliary reservoir pressure was already in the brake-cylinder, no further flow took place upon the opening of valve 22 (15).

579 X Q. In drawing No. 6 of Defendants' Exhibit Illustrative Cuts, does not the red line correctly show how the air moves from the auxiliary reservoir to the brake-cylinder, when the triple valve is in the position there illustrated?

A. In practical operation, the only time in which air from the auxiliary reservoir can take the course indicated by the red line is when air is also entering, or has entered, from the train-pipe.

580 X Q. Having answered a question that I did *not* ask you, will you now please answer the question that I *did* ask you?

A. In drawing No. 6 the red line correctly shows how the air moves from the auxiliary reservoir when the triple valve is performing a quick application, that is to say, when train-pipe air is being, or has been, admitted to the brake-cylinder.

581 X Q. And, under such conditions, the auxiliary reservoir air passes to the brake-cylinder through the port controlled by the valve 22 (15), does it not?

A. Yes.

582 X Q. One of the functions of the plain triple valves known

in the art prior to 1887 was to control the admission of auxiliary reservoir air to the brake-cylinder, was it not?

A. It was.

583 X Q. In the patent in suit, No. 360,070, does the valve 41 control the admission of air from the auxiliary reservoir to the brake-cylinder?

A. It does not.

584 X Q. In that respect, then, the valve 41 of the patent in suit differs in function from the valve 22 (15) of the defendants' apparatus, which does control the admission of air from the auxiliary reservoir to the brake-cylinder; am I not correct?

Objected to for the reason that the question is based upon an allegation of defendants' counsel which makes him a witness in the cause, to wit, that the valve 22 (15) of the defendants' apparatus *does* control the admission of air from the auxiliary reservoir to the brake-cylinder.

The objection objected to, as an attempt to instruct the witness how to answer.

A. I do not consider that the valve 41 of patent 360,070 differs in function from valve 22 (15) of defendants' apparatus. In both structures, the valves referred to perform useful functions only when train-pipe pressure is being admitted directly to the brake-cylinder.

In the defendants' structures, as previously stated, auxiliary reservoir air passes through the port of valve 22 (15) when, or subsequent to when, train pipe air has also passed through the same port, and I do not consider that the port or valve 22 (15) controls the flow of pressure from the auxiliary reservoir to the brake-cylinder, for the reason that communication is first made between the auxiliary reservoir and the brake-cylinder by the opening of valve port *i* (40), and if valve 22 (15) were not opened, and valve port *i* (40) were opened, then communication would still be open between the auxiliary reservoir and the brake-cylinder. If, however, the valve port *i* (40) were closed, then communication between the auxiliary reservoir and brake-cylinder would be entirely cut off, and, for this reason, I regard the valve port *i* (40) as controlling communication between the auxiliary reservoir and the brake-cylinder, and not the valve 22 (15).

584 X Q. You have testified that, under certain conditions, in the defendants' apparatus, air passes from the auxiliary reservoir to the brake-cylinder through the port controlled by the valve 22 (15). You have also testified that under no conditions does air pass from the auxiliary reservoir to the brake-cylinder, in the apparatus of patent 360,070, through the port controlled by the valve 41. It appears, therefore, that, under a given condition, auxiliary reservoir air passes to the brake-cylinder through the port controlled by the valve 22 (15), while, in the other apparatus, under the same conditions, it does not pass through the port controlled by the valve 41. In that respect, then, the valves 41 of the patent in suit and 22 (15) of the defendants' apparatus differ in function, do they not?

A. The facts with respect to the passage of air in the structures in question, are stated correctly in substance in the question, but I do not think that the valves 41 and 22 (15) differ in function, because neither of these valves controls the flow of auxiliary reservoir pressure to the brake-cylinder.

585 X Q. The valve 22 (15) of defendants' apparatus controls the flow of auxiliary reservoir air *through its own port* to the brake-cylinder, does it not?

A. In the sense that when the valve 22 (15) is opened, and auxiliary reservoir pressure is flowing through its port into the brake-cylinder, and when it is closed and air is not flowing from the auxiliary reservoir into the brake cylinder through its port, the valve 22 (15) controls its port or passage.

586 X Q. You mean that when valve 22 (15) is opened, air flows through its port from the auxiliary reservoir to the brake-cylinder, and when said valve is not opened, air does not flow through its port from the auxiliary reservoir to the brake-cylinder, do you?

A. That was not the exact meaning I intended to convey, for, as a matter of fact, it is only under conditions previously stated that air ever flows from the auxiliary reservoir to the brake-cylinder through the port controlled by the valve 22 (15).

Adjourned to Tuesday, December 19, 1893, at 10 a. m.

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NEW YORK, December 19, 1893—10 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of H. H. WESTINGHOUSE resumed:

587 X Q. When the air pressure in the auxiliary reservoir is higher than the air pressure in the brake-cylinder, in the defendants' apparatus, the valve 22 (15), if opened, allows the auxiliary reservoir air to pass through its port into the brake-cylinder, and, if closed, prevents any air from passing through its port into the brake-cylinder, does it not?

A. It does.

588 X Q. Under the same circumstances, in the apparatus of patent 360,070, the valve 41, if opened, does not allow auxiliary reservoir air to pass through its port to the brake-cylinder, and exercises no control over the passage of auxiliary reservoir air to the brake-cylinder; am I not correct?

A. Your statement of facts seems to me to be correct, but, as in X Q. 587, when referring to the passage of auxiliary air through the port controlled by valve 22 (15), it was not stated that the passage of air from the auxiliary reservoir to the brake-cylinder was controlled by valve 22 (15). I do not wish this answer to be construed as expressing the opinion that valve 22 (15) in defendants' apparatus controls the flow of pressure from the auxiliary reservoir to the brake-cylinder, in any practically operative sense, to any greater extent than the same function is performed by valve 41 in the structure of patent 360,070.

All of the above answer after the words "Your statement of facts seems to be correct," objected to by defendants' counsel as not responsive, but volunteered and argumentative.

589 X Q. Valve 22 (15) controls the flow of auxiliary reservoir pressure through its own port, does it not?

513 A. I do not think it does, for if it did control the flow of auxiliary reservoir pressure to the brake-cylinder through its own port, then it should have the capacity of limiting the flow, if it were desired to reduce the flow of pressure below the maximum rate. In practical operation this valve has only two positions. It is either held to its seat, so that there is no passage of air through its port, or else it is completely removed from its seat, so that the flow of auxiliary reservoir pressure, whenever such flow takes place through the port controlled by valve 22 (15), is controlled by the size of port B (c), which is much smaller than the port controlled by valve 22 (15).

I think my understanding of the question of control of auxiliary reservoir pressure, in the defendants' valves, can be explained by an illustration.

The ports controlled by valve 22 (15) and valve port *i* can be compared to the construction of doors sometimes found in establishments for manufacturing large and heavy machinery. In the construction of these doors, it is quite common to find the larger door having within it a smaller one, the smaller one being of a size suitable for the use of workmen to pass in and out of the building, and the larger one to be opened and to be used for the taking out of large machinery that could not be passed through the opening controlled by the smaller door. In such construction, whenever the larger door is opened, the smaller door necessarily goes with it.

Under the described conditions, I regard the smaller door as the one which controls the passage in the manufactory through which the workmen pass in and out of the building, and the larger as controlling the passage through which large and heavy machinery is taken in and out of the building. The fact that the larger door is closed, in no way affects the capacity of the smaller door to perform the function of admitting the workmen, and the opening of the larger door does not facilitate their going in and out, and is only useful for the purpose of admitting machinery that could not
514 be taken in through an opening of the size of the smaller door, and which is intended principally for the passage of workmen.

It seems to me that these conditions substantially exist in defendants' structure, with reference to the control of the passage of auxiliary reservoir air to the brake-cylinder. The valve port *i* admits auxiliary reservoir pressure to the brake-cylinder, in the degree and in the manner essential in structures of this kind, and it can be admitted through this port, or its flow to the brake-cylinder can be cut off, without moving, or in any way operating, valve 22 (15).

By the opening of valve 22 (15), which corresponds to the opening of the large door, the admission of train-pipe pressure is rendered

possible, which is an operation that could not be in any way affected by the opening of valve port *i*. The opening of valve 22 (15) practically carries with it the opening of valve port *i*, the same as the opening of the large door practically carries with it the small door, and the opening it controls, so far as any useful effect is concerned. When the valve 22 (15) is opened, and the auxiliary reservoir pressure is higher than the train-pipe pressure, it necessarily flows through the port opened by valve 22 (15), but the port 22 (15) has no control or limiting effect upon the flow of auxiliary reservoir pressure, because the passages leading from the auxiliary reservoir to the port controlled by valve 22 (15) are less in size than the port 22 (15). In the same way, the opening of the large door does not in any way facilitate the passage of the workmen in and out of the building, as compared with the opening of the small door alone.

This explanation, I think, will make clear my views upon the question of control of the flow of auxiliary reservoir pressure to the brake-cylinder in the defendants' apparatus.

590 X Q. Whether or not the opening of the port 22 (15) has a
 "limiting effect" upon the flow of auxiliary reservoir pressure
 515 to the brake-cylinder, it does, when opened, have an *enlarging*
 effect upon such flow, does it not?

A. From an examination of the drawing of the structure as shown in defendants' 1891 catalogue, I should suppose it did have the effect described, as the valve port *i* is represented as smaller than the valve port B. In the structure shown in the drawing of defendants' 1889 catalogue, I do not think it has this effect, as the port controlled by valve 13 is represented as being larger than the port *e*, and no greater flow of pressure could be accomplished by the opening of valve 22 (15).

Whatever may be the fact with respect to the particular sizes of these ports, with relation to each other, in the drawings referred to, in practical operation, there is no reason why the ports controlled by the graduating valves should not be of the same size, or a little larger than the ports B (*e*). I have made a valve like defendants' structure, in which the graduating passages were enlarged until their capacity was considerably in excess of the ports B (*e*), and this structure, seemed to perform, in every respect, substantially the same as the defendants' apparatus, as usually made by them in regular practice.

591 X Q. In the defendants' structure, the valve 22 (15) has the capacity to admit auxiliary reservoir air to flow through its port to the brake-cylinder, when said valve is opened and the reservoir pressure is higher than the cylinder pressure, has it not?

A. As already stated, auxiliary reservoir air does flow through the port controlled by valve 22 (15), under the conditions stated, and, if there were no other passage through which auxiliary reservoir air could enter the brake-cylinder, it would then seem to me to have the capacity stated, but I do not think, as the defendants' structure is now organized, that the valve 22 (15) can be said to have that capacity.

592 X Q. In other words, if I understand you correctly, your

516 meaning is this: That although the valve 22 (15), under the conditions stated, does actually *admit* auxiliary reservoir air to pass through its port to the brake-cylinder, yet it does not have the *capacity* of admitting air to pass from the auxiliary reservoir to the brake-cylinder, because the same kind of air is at the same time passing through some other port to the brake-cylinder; do I understand you correctly?

A. I do not think I correctly understood X Q. 591, as, under the conditions stated therein, valve 22 (15) has the capacity of opening and permitting auxiliary reservoir pressure to flow through it to the brake-cylinder.

593 X Q. You have heretofore defined the word "function" as meaning "capability," when applied to mechanical structures; under that definition, then, the valve 22 (15), under the conditions stated in X Q. 591, performs the "function" of admitting auxiliary reservoir air to flow through its own port to the brake-cylinder, does it not?

A. If the flow of auxiliary reservoir air through the port 22 (15) is described as a function, then the valve 22 (15) does control that function of its port.

594 X Q. The valve 22 (15) has the "capability" or "function" of opening its port under certain conditions of use, and thereby admitting air to flow from the auxiliary reservoir to the brake-cylinder through the port which it thus opens, has it not?

A. Yes.

595 X Q. Let us now turn our attention to the valve or valve port *i* (40). I understand you to say that in the defendants' apparatus the port *i* (40) is opened for the admission of auxiliary reservoir air to the brake-cylinder at the same time that the port controlled by the valve 22 (15) is opened; am I correct in this?

A. Yes.

596 X Q. It is also true, is it not, that when both of said ports are opened, air from the train-pipe, as well as air from the auxiliary reservoir, will pass through the port *i* (40)?

A. Yes.

517 597 X Q. In the apparatus of the patent in suit, No. 360,070, when the port 42 has been opened by the valve 41, and the port 22 has been opened by the valve port 35, is it true that air from the train-pipe, as well as air from the auxiliary reservoir, will pass through the port 35 and port 22?

A. No.

598 X Q. In defendants' apparatus, for example, as illustrated by plate XI (1891 catalogue), assume the bushing 9 to be wholly removed, but the apparatus not changed in other respects, and state what, if any, material differences there would be between the practical operation of such apparatus and the practical operation of the apparatus shown and described in the patent of Mr. George Westinghouse, Jr., dated October 14, 1879, No. 220,556?

A. In respect to the application of brakes, the two structures would operate in much the same manner, but the defendants' structure would require a considerable modification to enable it to perform

all of the functions of the device of patent 220,556, as well as they were performed by that device.

599 X Q. What functions would it not perform as well, and why?

A. It would not perform the operation of releasing the pressure from the brake-cylinder to the atmosphere, on a train of any considerable length, in a satisfactory manner, as the feeding-in passage, for controlling the flow of pressure from the train-pipe to the auxiliary reservoir, is not properly restricted.

600 X Q. It is restricted just as much in that device, with the bushing 9 removed, as it is in the same device with the bushing 9 in place, is it?

A. No, for with the bushing 9 in place, the flow of pressure from the train-pipe to the auxiliary reservoir is controlled by the size of port B, but when bushing 9 is removed, it is controlled by the size of port A which is much larger than port B.

601 X Q. As to everything except the release of the brakes, the defendants' apparatus, when modified by omitting the bushing 9, will operate substantially like the device of patent 220,556, if I understand you correctly; am I right?

A. In a general way, it would so operate.

602 X Q. Assume the defendants' apparatus with bushing 9 removed and port *i* (40) plugged, and state how the action of such apparatus, in practical use, would then compare with the action of the apparatus shown and described in the patent of George Westinghouse, Jr., dated January 11, 1876, No. 172,064.

A. The operation of the structure described would probably be somewhat less sensitive, in the matter of graduation, than the structure of patent 172,064, and, in a train of considerable length, as, for instance, one of twelve or fifteen cars, the application of brakes, in fully applying them, would be more uneven, that is to say, those upon the front portion of the train would be applied more quickly, relatively to those upon the rear of the train, as compared with a similar operation performed by the structure of patent 172,064.

These differences would exist, on account of the different forms of valve structure used to control the passage between the auxiliary reservoir and the brake-cylinder.

The proportioning of the ports and passages in the defendants' structure, when used in the manner described, is not of a kind to give the best results, were it to be used as modified.

603 X Q. The difference in sensitiveness to which you refer, results from using the plug form of valve 22 (15), instead of the slide form of the valve shown in patent 172,064, does it not?

A. This difference is not necessarily on account of the different forms of valves used, but on account of the proportions of these valves in the structures used.

604 X Q. The general mode of operation of the defendants' device, modified as stated in X Q. 602, would be the same, or substantially the same, as that of the device of patent 172,064, would it not?

A. It would.

605 X Q. And if we take the defendants' device, remove the bushing 9, but leave the port *i* (40) not plugged, the gen-

eral mode of operation of such device would be the same, or substantially the same, as that of patent 220,556, would it not?

A. I think my answer to X Q. 601 will answer this.

606 X Q. With the defendants' apparatus modified as stated in X Q. 602, that is to say, by removing the bushing 9 and plugging the port *i* (40), under which conditions it would have the same general mode of operation as the triple valve of patent 172,064, as you have testified, what part of the defendants' modified triple valve structure would correspond to, and perform the functions of, the valve H of patent 172,064?

A. The valve 22, with the stem 18 and the release valve 17, would correspond to slide-valve H of the structure of patent 172,064.

607 X Q. Assume the triple valve of patent 220,556 to be used on a train of five or six passenger cars, and assume that, by reason of an impending emergency, the engineer should open the engineers' valve wide open, and suddenly reduce the pressure in the train-pipe, so as to bring the pistons G to the full limit of their traverse, in such case the port *s*¹ would move past the port C very quickly, and but a small amount of auxiliary reservoir air would pass through the port *s*¹ into the brake-cylinder; am I not correct?

A. I think with the train of the length stated, the operation of the valves would be substantially as described in the question, although it is possible that, on the last one or two cars, the admission of air through port *s*¹ might be considerable in amount, before the complete traverse of the triple-valve pistons was made.

608 X Q. Assume the same train to be equipped with the quick-action triple valves of patent 360,070, and state how much auxiliary reservoir air would be admitted to the brake-cylinder, through the port 31 controlled by the graduating valve, when the brakes were applied under the conditions stated in X Q. 607, that is to say, were to be applied quickly, with full pressure, for emergency purposes?

520 A. There would be practically no admission of auxiliary reservoir air into the brake-cylinder, under the conditions stated.

609 X Q. How would it be if the train were composed of forty or fifty cars, equipped in the same way and operated under the same conditions?

A. There would be substantially no difference in the operation between the long and the short trains.

610 X Q. In the quick-action triple valve of patent 360,070, what is the use of graduating valve 29 and its port 31?

A. The use of graduating valve 29 is to aid the main valve 14 in performing the function of graduation. This result is accomplished by the moving of the triple-valve piston and the valve 29, without moving slide-valve 14, when the port 31 registers with the port 22.

With the construction as shown, as explained in a previous answer, a limited amount of pressure can be charged from the auxiliary reservoir to the brake-cylinder, by the movement of the triple-valve piston and slide-valve 29, without the necessity of moving the valve 14, and this mode of operation enables a smaller amount of

pressure to be charged into the brake-cylinder than would be the case if the valve 29 were removed, and graduation accomplished entirely by means of the movement of the slide-valve 14. Generally speaking, valve 29 aids the triple valve in performing the function of graduation more perfectly than the same work could be done without it, but its presence is in no way essential to the performance of the functions of the device shown in patent 360,070.

611 X Q. In the triple valve of patent 360,070, what would be the result if the port 35 were plugged?

A. In making an emergency application of the brakes, no appreciable auxiliary reservoir pressure would enter the brake-cylinder, if no other change were made in the construction of the device in question.

612 X Q. In such case, how much air pressure would get into the brake-cylinder, in attempting to make a quick application of the brakes?

521 A. Assuming a travel of six and a half inches for the brake-cylinder piston, and assuming a pressure of seventy pounds in the train-pipe, forty-three pounds would be admitted to the brake-cylinder.

613 X Q. If you based your last answer on an experiment or test of the matter, please state under what conditions such experiment was made.

A. The test was made upon a test-rack, with fifty triple valves, made substantially in accordance with the appliance shown in patent 360,070, and the result given was obtained by stopping up the port 35 and then making an emergency application of the triple valves.

In the test referred to, I am not sure that the graduating port was also stopped, but in other tests of a similar kind, it was found that the stopping of the graduating port and the port 35, did not materially, if at all, affect the amount of brake-cylinder pressure in making an emergency application, as compared with similar tests in which the port 35 alone was stopped.

614 X Q. In the triple valve of patent 360,070, if the port 42 were plugged and the valve 41 removed, what would be the effect in the operation of the structure?

A. It would operate as a plain triple valve.

615 X Q. In such case, what would be the action of the triple valves in a train of cars, if the train should accidentally break in two, and thereby suddenly discharge the air from the train-pipe?

A. If the train were of considerable length, the triple valves nearest to the fracture in the train-pipe would be operated so as to admit auxiliary reservoir air through port 35, and those on the rear portion of the train would probably admit a considerable portion of the auxiliary reservoir air to the brake-cylinder through port 31. If the train were a short train, then it is probable that all of the triple valves would operate so as to cause auxiliary reservoir air to pass through port 35 to the brake-cylinder.

522 The structure referred to was not designed or intended to be operated in the manner described in this question.

616 X Q. Under the conditions stated in my last question, that is to say, with the ports 42 plugged and valves 41 removed, and in the act of making an automatic application of the brakes, consequent upon the breaking in two of the train-pipe, how would the operation of the structure compare with that of the triple valves of patent 220,556, when in the act of making a similar automatic application of the brakes.

A. The movement of the triple-valve pistons would be substantially the same in both cases, but, with the device shown in patent 220,556, the flow of pressure from the auxiliary reservoir to the brake-cylinder of those triple valves that immediately uncover the port C by the full piston traverse, would be considerably more rapid than would be the case with the triple valves of patent 360,070, having a similar piston travel, and regulating the flow of air from the auxiliary reservoir to the brake-cylinder by means of port 35, because the port C is much larger than the port 35.

If the train were of considerable length, the operation of the structures on the rear of the train would be substantially the same. That is to say, in the device of patent 360,070, practically full auxiliary reservoir pressure would be charged into the brake cylinder through the port 31, and in the structure of patent 220,556 through the port s¹.

617 X Q. In said train having the triple valves of patent 360,070, with the passage 42 plugged and valve 41 removed, said triple valves would perform the four following functions, would they not?

1st. To admit air from the main air pipe to the auxiliary reservoir;

2d. To admit air from the auxiliary reservoir to the brake-cylinder, through the port controlled by the graduating valve 29;

3d. To admit air from the auxiliary reservoir to the brake-cylinder through the port 35; and

523 4th. To exhaust air from the brake-cylinder to the atmosphere?

A. The operations of the valves as described, upon a train of considerable length, would be substantially as follows:

If a reduction of pressure were made in the train-pipe, for the purpose of applying the brakes to a limited amount of auxiliary reservoir pressure, the triple-valve pistons would probably move to a point where communication would be opened from the auxiliary reservoir to the brake-cylinder through port 31, and, when the desired pressure had been charged into the brake-cylinder, communication between the auxiliary reservoir and the brake-cylinder would be cut off by the return traverse of the triple-valve piston, and this would be the mode of operation of all of the triple valves, when performing graduating work.

If it were desired to make a full application of the brakes, a full or complete reduction of train-pipe pressure would be made, and this would cause the triple-valve pistons of the devices nearest the point of the train-pipe opening, to make their complete traverse, and admit auxiliary reservoir pressure to the brake-cylinder, through port 35.

The pistons of the triple valves more remote from the point of train-pipe opening, would move to a point where the port 31 would open communication between the auxiliary reservoir and the brake-cylinder, and a portion of the auxiliary reservoir pressure would be charged into the brake-cylinder, and then the piston would complete its travel, and open communication between the auxiliary reservoir and the brake-cylinder, through port 35.

The pistons of the triple valves, on the rear portion of the train, would move to a point where communication between the auxiliary reservoir and the brake-cylinder would be made through the port 31, and complete auxiliary reservoir pressure would be charged into the brake-cylinder, before the pistons completed their entire traverse.

524 The operations of charging train-pipe pressure into the auxiliary reservoir, and exhausting air from the brake-cylinder to the atmosphere, would be performed in the usual manner.

618 X Q. With the explanations given in your last answer, the answer to my interrogatory 617 is *yes*, is it not?

A. It does not seem to me that the admissions of auxiliary reservoir air through ports 35 and ports 31 to the brake-cylinder are separate functions, otherwise I should suppose that the general assumptions of X Q. 617 were correct.

619 X Q. The admission of auxiliary reservoir air to the brake-cylinder through port 31, and the admission of auxiliary reservoir air to the brake-cylinder through port 35, are performed by different ports, at different positions of the main valve 14, and under different conditions, are they not?

A. They are performed by different ports, and by different positions of the triple-valve piston, but, as previously explained, under conditions of actual practice and under the same circumstances, some valves perform the admission through port 31, some through both ports 31 and 35, and some through port 35 alone.

620 X Q. Assume a train of five passenger cars, equipped with the triple valves of patent 360,070, having the passages 42 plugged and valves 41 removed, and state whether said triple valves would or would not perform, under all the conditions of actual use, the four functions specified in X Q. 617?

A. The operations of the triple valves in question, under the conditions named, would usually be, to admit auxiliary reservoir pressure to the brake-cylinder through the port 31, in making a graduated application of the brakes, and through port 35 in charging full auxiliary reservoir pressure into the brake-cylinder, although the operation of charging full auxiliary reservoir pressure would not be so quickly performed as if the traverse of the triple-valve

525 piston were limited to a point that would fully open port 31, as that port is considerably larger, in the structure of patent 360,070, than port 35, and such limitation of travel would obviously follow the stopping up of port 42 and the removal of valve 41.

It is also probable that, in making graduating applications of the brakes, auxiliary reservoir air would be admitted to the brake-

cylinder through the port 35, instead of port 31, upon the triple valves nearest the locomotive.

The functions of feeding train-pipe pressure into the auxiliary reservoir, and releasing train-pipe pressure to the atmosphere, would be performed in the usual manner.

621 X Q. With the explanations given in your last answer, the proper answer to X Q. 620 is "They would," is it not?

A. Referring to X Q. 620, it seems that this question refers to X Q. 617, and this question seems to assume that the admission of auxiliary air through the ports 31 and 35 are several functions, and as I do not regard the matter in this light, my answer would not be as stated.

622 X Q. If the admissions of auxiliary reservoir air through port 31, and through port 35, are properly to be regarded as separate functions, then the triple valves referred to in X Q. 620 would perform the four functions specified in X Q. 617, would they not?

A. If the admissions of auxiliary reservoir air to the brake-cylinder through ports 35 and 31, are two separate and independent functions, then the addition of the functions of admitting train-pipe air to the auxiliary reservoir, and releasing air from the brake-cylinder to the atmosphere, would, with the two assumed functions, make four in all.

623 X Q. And they would be the four functions specified in X Q. 617, would they not?

A. Yes.

624 X Q. You have heretofore testified that the triple valves of patent 360,070, with the passages 35 plugged, and with no other change in the structures shown in said patent, would admit but forty-three pounds air pressure into the brake-cylinder; how much is that short of the full amount which would be admitted to the brake-cylinder by the same valves, under the same conditions of pressure in the auxiliary reservoir and train-pipe, when the ports 35 were not plugged?

A. About twenty pounds.

625 X Q. The function of admitting that twenty pounds to complete the pressure in the brake-cylinder, is a function performed by the port 35, and not by the port 31, am I not right?

A. You are correct as to the structure shown in patent 360,070, but it could be equally performed by port 31.

626 X Q. How can that be true, in view of the fact to which you have just testified, namely, that when port 35 was plugged, the said twenty pounds of air pressure were not admitted to the brake-cylinder, although the port 31 was not plugged?

A. I did not intend to convey the impression that it could be equally well done, in the structure as shown in patent 360,070, by the port 31, as by port 35, without a structural modification. What I had in mind was, that the making of a cavity in the face of the slide-valve, as shown in the drawing "Exhibit Westinghouse Modification," would permit the feeding of the additional auxiliary reservoir pressure into the brake-cylinder through port 31.

627 X Q. The cavity marked *x* in Complainants' Exhibit West-

inghouse Modification, and described in your answer to Q. 450, is merely the mechanical equivalent of the port 35, is it not?

A. It is not the exact mechanical equivalent of port 35.

628 X Q. Why not?

A. The construction shown in port 35 is such, that communication between the auxiliary reservoir and the brake-cylinder is cut off, during that portion of the traverse of valve 14 when the metal of the slide-valve between the ports 31 and 35, is passing over port 22, and in the modification referred to, the communication
527 between the auxiliary reservoir and the brake-cylinder is continuously open, from the time the port 31 registers with the port 22, until the triple-valve piston has completed its traverse.

629 X Q. Would this difference make any real, substantial, practical difference in the operation of the triple valve?

A. If properly made, it would have no substantial effect upon the practical operation of the device.

630 X Q. Assuming the triple valve of patent 360,070 to be used without any modification or change whatever, then the function of admitting the twenty pounds to complete the pressure in the brake-cylinder, as stated by you in answer to X Q. 624, and as referred to by me in X Q. 625, is a function performed by the port 35, and not by the port 31, is it not?

A. Under the conditions stated, the function is performed by the port 35.

631 X Q. Is it your understanding that the defendants' quick-action triple valves have the same general mode of operation as the quick-action triple valves of patent 360,070?

A. It is.

632 X Q. In the complainants' quick-action triple valve of patent 360,070, does not the port 35 admit auxiliary reservoir air to the brake-cylinder, at exactly the same point in the movement of the triple-valve piston, that said valve would admit auxiliary reservoir pressure to brake-cylinder, provided the port 42 were plugged, and the valve 41 removed.

A. It is not the only place in which auxiliary reservoir pressure would be admitted to the brake-cylinder, in the structure shown in patent 360,070, and it is not the place at all by which auxiliary reservoir pressure would be admitted to the brake-cylinder in actual practice, if the other obvious changes were made in the general structure, at the time the port 42 was plugged and the valve 41 removed.

As previously stated, under some conditions, the port 35 does admit auxiliary reservoir pressure to the brake-cylinder, and
528 the conditions and circumstances under which it so acts have been described in detail.

633 X Q. Having again answered a question that I did *not* ask you, will you now please answer the question that I *did* ask you, bearing in mind that said question contemplates no changes in the structure except such as are specified in the question itself?

A. I do not know of any other way to truthfully and *and* intel-

ligently answer the question than that contained in my previous answer.

The question X Q. 632, assumes that port 35 always admits air from the auxiliary reservoir to the brake-cylinder, when the triple-valve piston has made its complete traverse, and, as previously and frequently explained, under conditions of actual practice, it will often occur that there will be no flow of auxiliary reservoir pressure through the port 35 to the brake-cylinder, when the port is opened, for the reason that full auxiliary reservoir pressure has already passed into the brake-cylinder through port 31.

When the structure of patent 360,070 is made and operated in accordance with the illustration, auxiliary reservoir pressure will always flow through port 35, when the triple-valve piston is in a position to open communication from the auxiliary reservoir to the brake-cylinder, through that port.

634 X Q. The question assumed nothing of the kind. It simply assumed that with the triple valve of patent 360,070, auxiliary reservoir air would, under certain conditions, pass through port 35 to the brake-cylinder, because you have so testified. It assumed also that the same valves, with the port 42 plugged and the valve 41 removed, would, under certain conditions, permit air to flow from the auxiliary reservoir to the brake-cylinder, through the port 35, because you have so testified. And it simply asked you whether, with the triple valve of patent 360,070, the port 35 does not admit auxiliary reservoir air into the brake-cylinder, at exactly the same point in the movement of the triple-valve piston, that it would admit such auxiliary reservoir air to pass from the auxiliary
529 reservoir to the brake-cylinder, through the port 35, if port 42 were plugged, and valve 41 removed.

As you evidently misunderstood the meaning of X Q. 632, I now ask you again to answer it in view of the explanation of its meaning which I have just given.

A. As I now understand the question, you desire to know if, under certain conditions, auxiliary reservoir pressure will be charged into the brake-cylinder through port 35, when the structure of patent 360,070 has port 42 plugged, and valve 41 removed, with the triple-valve piston in the same position that it is in, in the structure of patent 360,070 without modifications, when the port 35 always admits auxiliary reservoir pressure to the brake-cylinder.

If I understand you correctly, my answer is, yes.

635 X Q. That does not quite express the meaning of my question, but I will try to make it clear by another.

Assume *any* condition of the triple valve of patent 360,070, under which port 35 admits auxiliary reservoir air to the brake-cylinder, and assume *any* condition under which the same triple valves, with port 42 plugged and valve 41 removed, the port 35 will admit auxiliary reservoir air to pass to the brake-cylinder, and state whether the position of the triple-valve piston will not be precisely the same in each instance, namely, will it not be at the extreme end of its full stroke in the direction towards the train-pipe.

A. In the construction shown in patent 360,070, and in the modi-

fication described, it is essential that the triple-valve piston should be in the same position, in each case, before there can be any flow of pressure from the auxiliary reservoir to the brake-cylinder through port 35. The question as to whether or not there *will* be a flow of pressure through port 35 when it is opened, depends upon whether or not the pressure in the auxiliary reservoir is greater than that in the brake-cylinder.

Adjourned to Wednesday, December 20, 1893, at 10 a. m.

530

NEW YORK, December 20, 1893—10 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of H. H. WESTINGHOUSE resumed:

636 X Q. In the defendants' quick-action triple valves, if the port *i* (40) be plugged, will the device still be capable of quick action?

A. It will be capable.

637 X Q. Assume said port *i* (40) to be plugged, and assume the normal pressure of seventy pounds to be present in the auxiliary reservoir and train-pipe, and that a quick action be made under those conditions, and state how much air pressure will enter into the brake-cylinder in such case.

A. About sixty pounds.

638 X Q. With such port *i* (40) plugged, would the defendants' apparatus be capable of performing the graduating function?

A. No.

639 X Q. With such port *i* (40) plugged, how many valves would take part in the performance of the quick-action function by defendants' triple-valve apparatus—I mean how many valves would take part in the admission of air pressure into the brake-cylinder, exclusive of the valve which closes the exhaust from the brake-cylinder to the atmosphere?

A. Two, the valve 22 (15) and check-valve 26 (9).

640 X Q. Assume the quick-action triple valve of patent 360,070 to have the passage 31 plugged, and that, with a normal pressure of seventy pounds in auxiliary reservoir and brake-cylinder, a quick action were made, how many valves in said apparatus would take part in the admission of air pressure into the brake-cylinder, exclusive of the valve which closes the exhaust from the brake-cylinder to the atmosphere?

531 A. Three; the main valve 14, emergency valve 41 and check-valve 49.

641 X Q. In the defendants' quick-action triple valves, the only difference that the plugging of the port *i* (40) would make in the operation of the apparatus, would be that it would eliminate or prevent the performance of the graduating function; am I not correct?

A. That is the effect it would produce.

642 X Q. And that is the only effect that it would produce, is it not?

A. I believe that is the only effect that will be produced.

643 X Q. In the suit of George Westinghouse, Jr., and The Westinghouse Air Brake Company, complainants, *vs.* The New York Air Brake Company, Isaac B. Newcombe, Royal C. Vilas, Charles A. Starbuck and John C. Thompson, directors, No. 4977, in the United States circuit court for the southern district of New York, the same being an infringement suit charging said defendants with infringing letters patent No. 376,837, No. 168,359, and No. 172,064, you testified as a witness for the complainants and gave the deposition contained in pages 160 to 177 of the printed record in that suit, did you not?

Objected to as not proper cross-examination.

A. I did.

644 X Q. In that deposition, X Q. 147 and your answer thereto were as follows, were they not?

"147 X Q. Do you agree with me that the invention described in patent 360,070 is not the combination of the train-pipe and the brake-cylinder by means of two passages, one controlled by a triple valve and the other controlled by an emergency valve?"

532 "A. I think the construction shown in patent 360,070 contains two passages from the train-pipe to the brake-cylinder—one controlled by the triple valve and the other by an emergency valve; but I am unable to state the nature of the invention that this patent relates to."

Same objection.

A. They were.

645 X Q. The emergency valve there mentioned by you was the valve 41, was it not?

Same objection.

A. It was.

646 X Q. In the operation of the quick-action triple valve of patent 360,070, for quick-action purposes, in the normal action of the valve 41, when said valve unseats to admit train-pipe air directly to the brake-cylinder, does it open its port 42 wide open, or is it intended to be able to adjust or graduate the opening of said port in a quick action, so as to admit more or less air to pass through port 42?

A. The intended operation of the device is to open the port 42 to its fullest extent, and there is no graduation of train-pipe pressure admitted through this port.

647 X Q. In X Qs. 598 to 601 inclusive, and your answers thereto, and in X Q. 605 and your answer thereto, you testified, in substance, that the defendants' apparatus, with the bushing 9 removed, would operate substantially like the triple-valve apparatus of patent 220,556; that being the case, it would not be capable of performing quick-action functions, would it?

A. It would not.

648 X Q. The restoration of the bushing 9, which was assumed to have been removed, would render the defendants' device a quick-

action triple valve, fully capable of performing the quick-action functions, would it not?

A. It would.

533 649 X Q. In your answer to Q. 449, you testified that the defendants' structures do not possess the capacity of producing the same effect, in a service application of the brakes, as is produced if the piston and valve H of patent 220,556 are allowed to make the extreme traverse which the patent shows they are capable of making; what did you mean by that answer?

A. The idea intended to be conveyed was as follows: In the device of patent 220,556, limited amounts of auxiliary reservoir pressure, or the maximum amount, can be admitted, through either the small port s¹ or the larger port C, while, in the defendants' structure, the only admission of auxiliary reservoir pressure in process of operation is through the small valve port i.

The structure of patent 220,556, by means of this difference, has the capacity of two rates of application of the brakes by auxiliary reservoir pressure, under some circumstances, while the defendants' structure has only one rate for the purpose of application of brakes by auxiliary reservoir pressure.

650 X Q. In the defendants' structures, if the bushing 9 were removed, the structures would have the capacity of producing the two rates of applications to which you refer, would they not?

A. They would.

651 X Q. In the New York suit above referred to, No. 4977, one David Leonard Barnes was produced and examined as a witness for complainants, and gave a deposition printed on pages 177 to 189 of the complainants' printed record in that case. In his said deposition, on page 181, when speaking of the accidental breaking in two of trains, he testified as follows;

"Probably there are nine cases of breaking in two, under the conditions of present railroad service, in which the emergency feature is called into service and prevents wrecks, to every one case where the emergency feature is operative by the hand of the engineer in the cab, to prevent collision. This shows the necessity of

534 having not only the quick-action feature, but also that what is more essential is, that that feature should be automatic."

Do you agree with Mr. Barnes in his said testimony above quoted?

A. Yes.

652 X Q. Said record in the New York case shows that your testimony quoted in X Q. 644 was given on the 14th day of January, 1892, and Mr. Barnes' testimony above quoted, was given on the 18th day of January, 1892, does it not?

Objected to as not proper cross-examination, irrelevant and immaterial.

A. Yes.

Redirect examination:

653 Re-D. Q. I understand from your answers 440 and 441 in chief,

that triple valves, such as were known in the art prior to 1887, possessed three functions, to wit:

First, The admission of air from the train-pipe to the auxiliary reservoir; *second*, the admission of air from the auxiliary reservoir to the brake-cylinder; *third*, the release of air pressure from the brake-cylinder to the atmosphere.

You have also stated in substance, in answer to X Q. 519, and other answers in your cross-examination, that the triple valve of patent 141,685, and others of earlier date than 1887, possessed the capacity or capability of providing for the admission of air from the auxiliary reservoir to the brake-cylinder, either of maximum pressure, or in various degrees less than the maximum pressure.

As a mechanical engineer, familiar with air-brake practice, please state what, if any, difference of function, principle, or mode of operation existed, in any of the triple valves prior to 1887, to which you have referred, in effecting the admission of reservoir air to the brake-cylinder, either at maximum pressure or at a lesser degree of pressure, and, if such admission function is to be divided, into how many different degrees less than the maximum would it be possible to divide it?

Objected to as vague and immaterial.

A. All of the valve structures in question perform the function of admitting auxiliary reservoir pressure to the brake-cylinder in the same general manner, and, while some of the later constructions facilitated the charging of small amounts of pressure into the brake-cylinder, yet the mode of operation in every case was practically the same.

I do not see that the functions can be divided into degrees. The function was the same, and performed practically in the same manner, whether it was exercised to the extent of admitting all of the pressure into the brake-cylinder, or only some portion of it.

654 Re-D. Q. You have been cross-examined at some length as to whether or not the admission of auxiliary reservoir air to the brake-cylinder is *controlled* by the valve 22 (15) in defendants' structures, and in answer to X Q. 594 have admitted that defendants' valve 22 (15) has the capability of opening its port, under certain conditions of use, and thereby admitting air to flow from the auxiliary reservoir to the brake-cylinder through the port which it opens.

So far as useful results in practical railroad service are concerned, to what extent, if at all, is the capability of valve 22 (15), above referred to, a necessary or a useful feature of defendants' structures?

A. It is not a needed or useful device, in practical operation, for the admission or control of auxiliary reservoir pressure.

655 Re-D. Q. Referring you to drawing "Exhibit Westinghouse Modification," please state of what valve port, and of what valve port only, the valve recess, or port opening *x*, is a portion or extension, and with what valve port only it is in any manner operated?

A. Valve port 31.

656 Re-D. Q. In the construction illustrated in the drawing, Exhibit Westinghouse Modification, what, if any, *additional* valve port has been substituted for the eliminated valve port 35?

A. None.

H. H. WESTINGHOUSE.

Defendants' counsel states that complainants' counsel now informs him that he proposes to take the testimony of three witnesses, namely, Mr. David Leonard Barnes, as an expert, and Mr. Levi Close and F. Nellis, railroad locomotive engineers, as to certain questions of fact.

Defendants' counsel therefore makes the following statement:

Early in November, 1893, complainants' counsel notified defendants' counsel that he would proceed with complainants' testimony at New York city on November 10th. Defendants' counsel, being unable to attend upon the same before November 24th, informed complainants' counsel to that effect, and suggested that complainants' counsel commence on November 24th, 1893, instead of November 10th, 1893, and that, in such case, defendants' counsel would be willing to extend complainants' time for taking testimony, so as to make up for the time lost between November 10th and November 24th. Complainants' counsel thereupon courteously assented, on condition that complainants' time should be extended as above stated. Defendants' counsel thereupon, in writing, agreed to extend complainants' time for taking testimony to and including December 15th, 1893.

537 The taking of complainants' testimony, accordingly commenced at New York city on the 24th day of November, 1893, with the testimony of Mr. Henry F. Newbury, their expert, and continued, from day to day, until Mr. Newbury's testimony was concluded, at noon of Thursday, December 7th, 1893. On Wednesday afternoon, December 6th, complainants' counsel informed defendants' counsel that after Mr. Newbury's cross-examination was completed he should take the balance of his testimony at Pittsburgh, Pa., commencing Monday morning, December 11th. Defendants' counsel protested against the change from New York to Pittsburgh, and requested complainants' counsel to produce his witnesses at New York and proceed with his testimony there.

On Thursday morning, December 7th, complainants' counsel informed defendants' counsel that, in view of all the circumstances, he would proceed at New York instead of Pittsburgh, but that he should not be able to produce his further witnesses at New York until Monday morning, December 11th, and, as defendants' counsel understood him, that he might want a day or two after December 15th in which to complete his testimony. This conversation took place on the train coming down from the hotel to the place of taking testimony.

Mr. Newbury's testimony was closed at noon that day. During the day, while present in the room where the testimony was taken, the subject of further proceeding was brought up and discussed between complainants' and defendants' counsel, Mr. Charles B. Mann,

and Mr. George A. Boyden, and, as defendants' counsel remembers the facts, there was an agreement made orally between the parties present that, in view of the fact that complainants' counsel would lose Thursday afternoon, Friday and Saturday, complainants

538 should have an extension of time to make up for such loss, and that if complainants' testimony should run a day or two longer than even that, then defendants and their counsel would not object. Complainants' counsel stated, during both of those conversations, namely, in the morning coming down, and during the day in the presence of Mann and Boyden, that he proposed to examine only two witnesses, to wit, viz. H. H. Westinghouse and David Leonard Barnes.

The above states the understanding between counsel and parties, substantially as it is remembered by defendants' counsel, and as it was understood by him at the time; and with that agreement, an adjournment was taken to Monday morning, December 11th.

On Monday morning, December 11th, complainants' counsel commenced the examination of Mr. H. H. Westinghouse at New York city and continued it until the close of the day's session on Thursday, December 14th. The cross-examination then commenced and continued until Wednesday noon, December 20th.

At the close of Mr. Westinghouse's testimony, complainants' counsel notified defendants' counsel that he desired to adjourn to Thursday morning, December 21st, when he would proceed with the testimony of Mr. Barnes, and that he also proposed to take the testimony of Mr. Close and Mr. Nellis. Defendants' counsel stated that, according to his understanding of the arrangements made between counsel and parties, complainants' time for taking testimony, even under the extension granted, had already expired, and that he objected to the testimony being prolonged indefinitely. Complainants' counsel stated, in reply, that, according to his understanding of the arrangement, he was to have all the further time that he needed to complete his testimony, provided that he went right along with it, without any delay, until it

539 should be completed, and that to prevent him from taking the testimony of Mr. Barnes, Mr. Close, and Mr. Nellis, would be to deprive him and his client of a portion of the evidence which they desired to take in their behalf. To this, defendants' counsel replied, inquiring what the testimony of Mr. Close, Mr. Nellis, and Mr. Barnes would be, and was informed that the testimony of Mr. Close and Mr. Nellis would relate to certain facts in their experience with defendants' quick-action brakes, and that the testimony of Mr. Barnes would be in the nature of expert testimony. Defendants' counsel, thereupon, stated that he did not wish to deprive complainants of any of their evidence even though, according to his understanding, complainants' time had expired, and that, therefore, he would be willing to stipulate, and would stipulate on the record, that Mr. Close and Mr. Nellis would testify to the facts which complainants' counsel had stated they would swear to, and also to stipulate on the record that Mr. Barnes would testify in corroboration of Mr. H. H. Westinghouse, and in opposition to the testimony of

Messrs. Boyden and Church, wherever it might conflict with the testimony of Mr. Westinghouse. These stipulations would give the complainants the benefit of the evidence of all three of the witnesses whom they wished to examine, and would save the spending of any further time in completing the complainants' case.

Complainants' counsel expressed himself as willing to accept the stipulation as to the testimony which would be given by Mr. Close and Mr. Nellis, but unwilling to accept it in lieu of the testimony of Mr. Barnes, and stated that he wished to proceed with the testimony of Mr. Barnes on Thursday morning, December 21st.

Defendants' counsel now states that, with his understanding of the arrangement, he is unwilling to consent to the spending of any more time in the examination of complainants' witnesses, and that, if complainants desire to take such testimony, he shall object to it as taken out of time, unless the complainant shall first procure an order of court for such further extension, upon showing good cause therefor.

Inasmuch as complainants' counsel now proposes to adjourn until tomorrow morning, December 21st, 1893, and then to proceed with the testimony of Mr. Barnes, without obtaining an order of court further extending complainants' time, defendants' counsel states that, in view of prior imperative engagements, made upon the understanding that complainants' time for taking testimony would not run more than two or three days beyond December 15, he will be unable to be present during such taking of Mr. Barnes' testimony, and that, if such testimony be taken, he shall, at the hearing of the cause, object to it as taken out of time and without authority of law. He further gives notice to complainants' counsel that if the latter shall apply to the court for an extension of time for taking testimony, the defendants will, at the same time and place, apply to the court for an order fixing the day of hearing at some definite future time which will enable the counsel on both sides to prepare and print their briefs and get ready for the argument.

Mr. J. Snowden Bell, of counsel for complainants, desiring, at the outset, to be understood that he does not make, even by implication, any reflection whatever upon counsel for defendants, as to his misunderstanding of the clear and specific agreement entered into between counsel, states as follows:

In the first place counsel for defendants has omitted to state that which is the fact, to wit, that counsel for complainants, some
541 time in the latter part of October, 1893, wrote counsel for defendants, proposing to commence the taking of complainants' testimony in reply, at a much earlier date than November 10th, being as counsel for complainants now remembers, on or about November 1st, 1893, and possibly earlier, but not being able to refer to copies of his correspondence, which are in his Pittsburgh office, he cannot, with absolute accuracy, state the date at which he then proposed to commence.

Counsel for defendants replied, in substance, that he would be engaged in other cases, at and about the time suggested, and up to November 8th, on which date he stated that he had an engagement

before the United States circuit court, or circuit court of appeals, in some western circuit. Counsel for complainants remembers it as being in Iowa, but counsel for defendants states that it was an engagement in Milwaukee, which is doubtless correct. Counsel for complainants thereupon, and by reason of the engagements of defendants' counsel, and for no other reason, delayed the commencement of his testimony until November 10th, being, as he supposed, the earliest day that defendants' counsel could attend, and thereby losing about ten days or more of the time allotted him.

Upon writing defendants' counsel and suggesting November 10th as the day of commencement, defendants' counsel replied in substance, that in view of his engagements, it would be a personal favor or accommodation to defendants' counsel to postpone the taking of complainants' testimony in reply until November 24th, and that, in such case, defendants' counsel would correspondingly extend complainants' time, which he accordingly did in writing, but no allowance whatever was made for the time which had theretofore been lost by reason of defendants' counsel's western engagement up to November 8th.

542 As stated by counsel for defendants, the question as to continuing testimony, after Mr. Newbury's cross-examination should be completed, was discussed between counsel on Wednesday afternoon, December 6th, and, in view of the unwillingness expressed by defendants' counsel to have the further examination of the witnesses proceed in Pittsburgh, counsel for complainants sought to make some agreement with defendants' counsel which should cover this point, as well as cover such further extension of time as might be necessary to complete complainants' evidence, and which further extension complainants' counsel did not for a moment suppose defendants' counsel would refuse, in view of the delay occasioned in beginning the testimony in reply, due altogether, as before stated, to the engagements of defendants' counsel.

On Thursday morning, December 7th, complainants' counsel met defendants' counsel at the Forty-second Street station of the Sixth Avenue railroad, and then and in the train coming down, made an agreement for an extension of time with defendants' counsel, which complainants' counsel perfectly and clearly remembers, it being a matter which he was then very desirous to satisfactorily arrange, and one which was very clearly impressed on his memory. That agreement was as follows:

Complainants' counsel stated to defendants' counsel that he would endeavor to arrange to bring his witnesses to New York and to take their testimony there, and take it continuously until completed, stating that he desired to take the testimony of Mr. H. H. Westinghouse and Mr. D. L. Barnes, and asked defendants' counsel whether, if he made such arrangement, defendants' counsel would
 543 allow him *whatever time might be necessary* to complete complainants' evidence. Complainants' counsel remembers perfectly well, that there was not a word said, and not the slightest intimation given, that only a day or so, or any such comparatively short time, would be required, and the request for exten-

sion was made without any limitation whatever, either direct or such as could be implied in the terms of complainants' counsel's language. Defendants' counsel very readily and cheerfully, as it seemed to complainants' counsel, agreed to this proposition, without any discussion or objection, and appeared to be entirely satisfied with it.

Some time during the morning, while the depositions were being taken, there was some conversation with reference to an extension of time with Mr. Charles B. Mann, of counsel for defendants, Mr. Mann asking something as to the conclusion of the testimony, or about going to Pittsburgh, and complainants' counsel replying that he had made an agreement for an extension of time with Mr. Hill, of defendants' counsel, under which the testimony would be taken here in New York. Mr. Mann appeared to be entirely satisfied with this statement, and whether he was or not, no discussion whatever was held with him, or with any one else, by complainants' counsel, as the latter considered his agreement with Mr. Hill, as above stated, to be conclusive, and did not see the necessity of discussing it with anybody else. After the conclusion of the testimony on that day, Mr. Bell saw Mr. George H. Christy, managing counsel for complainants, and reported to him the agreement that he had made with Mr. Hill, in terms substantially as above stated. He went to Pittsburgh that same night, made the necessary arrangements with his witnesses, and commenced and continued the

544 further taking of testimony on December 11th, as stated by defendants' counsel, closing the redirect examination of Mr. Westinghouse this afternoon, when, to his extreme surprise, he discovered that defendants' counsel had wholly misunderstood the terms of the extension made by him, and now was desirous of cutting short the further taking of testimony.

In view of the position taken by defendants' counsel, as indicated in his preceding statement, complainants' counsel thinks it may be the proper course to submit this question to the court, although as he understands the practice in this circuit, the taking of testimony which has been continued after the expiration of a limit fixed by the court, or of a stipulation of the parties, cannot be summarily abridged by either party, and cannot be terminated except by an order of the court, or the consent of the parties.

Whether or not the same practice prevails in the Maryland district, complainants' counsel does not know, and he therefore gives notice on the record that on tomorrow, Thursday, December 21st, 1893, at 10 o'clock a. m., or as soon thereafter as counsel can be heard, he will move such judge as may then be sitting in the United States circuit court for the district of Maryland, for an order extending the time for the taking of complainants' proofs in reply, for the period of ten days from date.

Defendants' counsel accepts service of the notice given by Mr. Bell of his proposed application to the court at Baltimore tomorrow and notifies complainants' counsel that, at the same time and place, application will be made on behalf of the defendants, for an order fixing the time of trial at some reasonable date in the future.

545 Defendants' counsel further states that his memory is very strongly impressed with the fact that during the conversation with complainants' counsel on the elevated railroad train on the morning of December 7th, or during the conversation between Mr. Bell, Mr. Mann, Mr. Boyden and Mr. Hill on the same day, reference was, in terms, made to the extension for two or three days immediately after the 15th of December. At all events, inasmuch as complainants' counsel then proposed to take only the testimony of Mr. H. H. Westinghouse and Mr. Barnes, and there was nearly a week remaining for that purpose, defendants' counsel throughout the entire matter, had in mind only a short extension of two or three days after December 15th, so as to practically make up for the time lost between December 7th and December 11th by the adjournment that then occurred, and never dreamed of an indefinite extension of time being meant or understood by either counsel, nor that any other witness was to be examined except Mr. Westinghouse and Mr. Barnes. The fact that it was also proposed to examine Mr. Close and Mr. Nellis was first made known to defendants' counsel after the close of the redirect examination of Mr. H. H. Westinghouse today.

In view of the evident misunderstanding between counsel, defendants' counsel concurs with complainants' counsel in thinking that the matter had better be settled by the court.

Adjourned to Friday, December 22d, 1893, at 10 a. m.

546

NEW YORK, *December 22, 1893.*

Met pursuant to adjournment.

Present: *J. Snowden Bell, Esq.*, of counsel for complainants, and no appearance on behalf of defendants.

In accordance with a stipulation extending complainants' time for taking proofs in reply, made and filed in the clerk's office of the United States circuit court for the district of Maryland, the further taking of testimony is adjourned to Tuesday, January 2, 1894, at 11.30 a. m.

NEW YORK, *January 2, 1894—11.30 a. m.*

Met pursuant to adjournment.

Present: *J. Snowden Bell, Esq.*, of counsel for complainants; *Charles B. Mann, Esq.*, of counsel for defendants.

DAVID LEONARD BARNES, a witness produced on behalf of the complainants, having been duly sworn, deposes and says in answer to interrogatories propounded to him by *J. Snowden Bell, Esq.*, of counsel for complainants, as follows, to wit:

657 Q. What is your name, age, residence and occupation?

A. David Leonard Barnes, age 35, Chicago, Ill., consulting engineer in railway and mechanical construction.

658 Q. To what extent are you practically familiar with the construction and operation of railroad machinery, more particularly with fluid-pressure brake apparatus?

A. I have been intimately connected with railroad work since 1878, and previous to that time I made a study of mechanical
547 and railroad engineering at Brown University, Providence, and Massachusetts Institute of Technology, at Boston. Prior to entering those colleges, and during the vacation, I spent, in all, about three years at civil engineering.

After leaving the college, I worked in the machine shop, and other departments of the Rhode Island locomotive works, in Providence, R. I., and the Hinkley locomotive works in Boston, Mass. In 1880, I entered the drawing-room department of the Rhode Island locomotive works and shortly thereafter was in charge of the drawing-room and the mechanical engineering work of the company, with the exception of one year, during which I was mechanical engineer for the Rome locomotive works at Rome, N. Y. During the succeeding period, up to the fall of 1887, it was my duty to design and test railroad apparatus, more particularly with reference to rolling stock, and it was necessary for me to know, and be familiar with, the details of construction and operation of air brakes as used in practical railroad service, and in 1887 I left the Rhode Island locomotive works, to go round the country with the Westinghouse experimental fifty-car air-brake train, for the purpose of familiarizing myself with the details of practical operation of the Westinghouse quick-action brake, which was then being brought into practical service. This I did preparatory to taking up a business of my own, as consulting engineer, in the city of Chicago. I commenced that business in November, 1887. Since that time I have acted as consulting engineer on special work for several railroads, among them the following: Chicago, Burlington and Quincy, the Mexican Central, the Baltimore and Ohio, the Illinois Central, the Chicago and South Side Rapid Transit Company, who built and operate the Alley Elevated in Chicago, and the Metropolitan Elevated in Chicago. I designed the compound locomotives, and arranged the braking systems, and adapted the quick-action brakes for use
548 on the Alley elevated road just mentioned, and did all the principal mechanical engineering of that road during its construction and up to this time.

I made a study of air brakes, both vacuum and compressed air, as used here and in foreign countries, and made a special study of the quick-action brakes, as brought out and developed in the Masters Car Builders' Association air-brake tests, at Burlington, Iowa, in 1886-1887. I have designed several quick-action air-brake triple valves, and have acted as consulting engineer for two manufacturers of air brakes of the quick-action type, and have made expert reports on five different air-brake systems. My work has been such as to bring me into intimate relation with the practical operation of air brakes, and I have conducted special tests of fifty-car air-brake trains in actual operation on railroads. This is the experience that I have had which relates more particularly to the use of automatic and quick-action brake systems.

659 Q. Have you read the depositions of defendants' witnesses, George A. Boyden and Joseph B. Church, in this cause?

A. Yes.

660 Q. As a practical expert in the art of automatic brakes for railroads, please state the several different functions, and the distinguishing and essential characteristics of a "triple valve," as such appliance was used in said art prior to 1887?

A. Prior to 1887, triple valves had three distinct functions, performed in a varying degree, and characterized as follows:

First function. When a locomotive is coupled onto a train equipped with triple valves such as were used in the art prior to 1887, air was admitted to the train-pipe from the main reservoir on the engine, and from the train-pipe was admitted to the auxiliary reservoir, by the triple valve.

Second function. After the train had started, and it was desired to stop, air was let out of the train-pipe in one of several ways, and air was admitted from the auxiliary reservoir to the brake-cylinder.

549 Third function. After the train had been stopped and it was desired to release the brakes, the pressure in the train-pipe was restored, by admitting air from the main reservoir on the engine, through the engineers' valve, to the train-pipe, and the triple valves operated to open a passage from the brake-cylinder to the atmosphere, and permit the pressure in the brake-cylinder to be released.

These are the three functions, and the only functions, which were performed by triple valves prior to 1887, and, as I have said before, these functions were performed in a varying degree as follows:

When the locomotive was coupled on to the train, and the air pressure admitted from the main reservoir on the engine, the triple valve operated to open a passage from the train-pipe to the auxiliary reservoir, quickly or slowly, fully or partially open, according to the size of the train-pipe, the pressure carried on the engine reservoir, and the position of the triple valve in the train. Generally, the valves on the front cars operated at once to open the full charging port, while those in the rear operated later, and the charging port was opened, fully or partially, according to the impulse given the piston or diaphragm of the valve by the incoming pressure, and according to the rapidity of increase of pressure in the train-pipe. If the pressure were increased very slowly, as is always the case in a long train at the rear, the charging port would be opened less rapidly, and sometimes, less fully, than when the pressure is increased more rapidly. It has been necessary, in the practical development of triple valves, to restrict the passage from the train-pipe to the auxiliary reservoir, in order to prevent the front brakes from being charged too quickly, and too long before the charging of the rear brakes. When this was not done, the front brakes became charged fully before the rear brakes were charged, and the reduction in the train pipe pressure, resulting from a subsequent charging of the rear brakes, caused the front brakes to apply, and this gave rise to practical difficulties. Necessarily,
550 any valve must open partially before it can open fully, and when the opening force is variable, the amount of valve opening may be, and will generally be, variable, also.

The second function of triple valves used prior to 1887 was performed in a variable way as follows:

In a short train, if the engineer operated the engineers' valve to let air out of the train-pipe in a rapid and energetic manner, the piston or diaphragm of the triple valve would move to its full stroke and open the application port or ports fully, and would then return quickly to the point where the application port was closed.

If the engineer operated the engineers' valve less energetically, the piston or diaphragm would move less forcibly and would open the application port to a less degree.

In a long train, the energetic movement of the engineers' valve would open the application port of the triples on the front cars at once and fully, while those on the rear cars would be operated less forcibly, and the port for application of the brakes would be opened in a less degree.

In the examples I have described, the function is, and the purpose is, to admit auxiliary reservoir pressure into the brake-cylinder to apply the brakes, and it is the same purpose, and the same function, whatever the amount of opening, or whatever be the force of the application of the brakes.

The variable performance of the third function is, as I have described in the case of the first and second functions, dependent upon the impulse which the valves receive from the variation in pressure in the train-pipe, and upon the rapidity of the increase or decrease of that pressure. The third function, which is that of release of the brakes, is generally performed quickly on the front of the train and more slowly at the rear. This is noticeable particularly in tests made of fifty brakes on a rack, where they can be observed
551 more carefully. If the piston or diaphragm of the triple valve is driven fully to the extreme of its stroke on the return, the release port is fully opened. As I have explained before, where there is a variable force operating a valve, the opening may be, and generally is, variable.

Having used the term function, I now wish to define the sense in which I have used it. The function of a valve or device is the purpose or office of the valve or device, and it has nothing whatever to do with its detail construction. It does not signify anything whatsoever in regard to location, dimensions, mass, or integrality.

In describing double, triple, quadruple, or any other compound valves, it is necessary to adhere closely to the functions of the valve, rather than the number of parts or details, for the reason that the number of functions is quite independent of the number of parts. For instance, in the arts there are quadruple and triple valves that have but two parts, and yet have quadruple and triple functions, as the case may be.

The concise reply to the question is, that triple valves, as used in the art of braking prior to 1887, have three distinct functions such as I have described, and these functions are all, and can all be, performed in a variable degree. The function is the same whether it is performed fully or partially.

661 Q. What, if any, distinguishing or essential characteristics

were possessed by triple valves, as known in the art prior to 1887, other or further than the structural capability of performing the three functions recited in the last preceding answer?

A. There were no other essential characteristics possessed by triple valves prior to 1887, or structural capabilities for the performance of any other than the three functions I have mentioned.

662 Q. The defendants' witnesses, Boyden and Church, have testified to the effect that triple valves proper, or triple valves such as were known in the art prior to 1887, had *four* separate functions (which they sometimes characterize as "valves" and sometimes as

552 "valve functions") and also to the effect that the performance of the admission of auxiliary reservoir air to the brake-cylinder (characterized by you in answer 660 as the second function of a triple valve prior to 1887) is *one* function when effected to the full or maximum extent, and is *another* and a different function when effected in a lesser degree.

As a mechanical engineer familiar with air-brake practice, state what, if any, difference in function, or in the manner of the performance of function, existed or exists in plain triple valves as known prior to 1887, as between a full, and a partial or lesser, admission of auxiliary reservoir air to the brake-cylinder?

A. As I have said before, it is necessary, in describing compound valves, to adhere to the functions rather than the details, as the functions of a valve are no indication of the number of parts, therefore the use of the term "valves" in the testimony of the defendants' witnesses Boyden and Church, is indefinite, as there may be more or less "valves" without changing the number of functions.

The term "valve functions" I understand to mean the same as "functions," and to be in fact the functions of the valve.

The second function that I have described is the function referred to in the question I am now answering, and it is but one function, namely, the office of admitting air from the auxiliary reservoir to the brake-cylinder. To admit *a little* air is no different function than to admit *more* air. To apply the brakes *slightly* by the admission of auxiliary reservoir air to the brake-cylinder, is no different function from applying the brakes *harder* or *fully* by the admission of more air from the auxiliary reservoir to the brake-cylinder.

To further explain what I mean by this, I will recite similar examples:

The office, purpose, and function of a faucet used in plumbing, is to admit water from the water pipes to a basin or a receptacle. It is the same function that is performed when one pint of water is drawn through the faucet per minute, as when one gallon is
553 drawn per minute. No different function is performed when the faucet is partly opened than when it is full open. The single function or office is to permit water to be drawn from the water pipe in any quantity that may be desired.

In air compressors, there are arranged a number of inlet valves, all performing the same function of admitting air to the air-compressor cylinders, on the forward stroke, and closing to prevent the escape of air on the backward stroke. When the compressor is

running rapidly, all of these valves will lift considerably, and, when the compressor is running slowly, only a few of the valves will lift, and the lift will be less than before. The valves are many in number, for the purpose of getting a better practical operation. The function of each valve, or of all valves combined, whether lifting much or little, is the same and single function of admitting air to the compressor cylinder to any desired amount. It is no different function that is performed when all of the valves lift, than when one lifts, and it is no different function when the valves lift to the full extent of their stroke, from that performed when they lift but little.

For these reasons which I have explained, it is to me clear that the defendants' witnesses Boyden and Church are not justified in subdividing the single function of admitting air from the auxiliary reservoir to the brake-cylinder into two functions, which they have described individually as differing only in degree of performance of the same function. Functions of all valves, so far as I know, are performed in a varying degree, but this does not make a difference in function *per se*.

A more illustrative example of a variable degree of performance of a single function, is found in the well-known Corliss engine, where the steam valves have the single function of admitting steam from the boiler to the cylinder, and the amount of opening of the valves and the amount of steam admitted is varied to suit the requirements of the work to be done. The same function is performed when steam is admitted for one-half of the stroke, as when admitted for the full stroke.

For the purpose of discussion or illustration, a function might be divided into degrees, but the difference in degrees would not make a difference in function; thus we have, in locomotive practice, the throttle valve partially open, half open, and full open, but the throttle valve performs the same function when open to either of these degrees.

663 Q. Are you familiar with the descriptive matter and representations of a quick-action triple valve contained in the specifications and drawings of the Westinghouse patent No. 360,070 in suit? In answering this, and any other questions which I may put to you regarding this or any other patent, you may understand that you are not interrogated as to the *claims*, and need not refer to them.

A. I am.

664 Q. In answer to question 6, in which he is asked to describe the construction and operation of the quick-action triple valve of the Westinghouse patent 360,070 in suit, defendants' witness, G. A. Boyden, makes the following statement, to wit:

"This is a valve mechanism used in automatic air brakes the functions of which are: 1st. To admit air from the main air pipe to the auxiliary reservoir, through the valve port or feeding-in groove 51, shown in Fig. 2 of complainants' patent No. 360,070. 2d. To admit air from the auxiliary reservoir to the brake-cylinder through the port controlled by the graduating valve 29, by the

preliminary movement of the piston 12. 3d. To admit auxiliary reservoir air to the brake-cylinder through the valve port 35 by the final movement of the piston. 4th. To exhaust air from the brake-cylinder to the atmosphere through the valve cavity 33. These four valves form what is commonly known as a 'triple valve' proper, as used in the art prior to 1887."

555 From your practical knowledge of the construction and operation of quick-action triple valves similar to that described and shown in patent 360,070, your knowledge of triple valves as known in the art prior to 1887, and your familiarity with the descriptive matter and drawings of patent 360,070, state whether or not the statement of Mr. Boyden above quoted is true and correct in fact.

A. The triple-valve functions Nos. 1, 2 and 3, that I have described as being all the functions performed by triple valves prior to 1887, are performed by the quick-action triple valve described and shown in patent No. 360,070, when operating as a plain triple valve, but are not performed as described by Mr. Boyden. I will quote from Mr. Boyden's reply:

"This is a valve mechanism used in automatic air brakes, the functions of which are:

"1st. To admit air from the main air pipe to the auxiliary reservoir, through the valve port or feeding-in groove 51, shown in Fig. 2 of complainants' patent No. 360,070" (D. R. p. 17).

This is correct.

"2nd. To admit air from the auxiliary reservoir to the brake-cylinder through the port controlled by the graduating valve 29, by the preliminary movement of the piston 12."

This is correct.

"3d. To admit auxiliary reservoir air to the brake-cylinder through the valve port 35 by the final movement of the piston."

This is incorrect, as it is impossible to open the port 35 when the quick-action triple valve of patent 360,070 is performing the functions of a triple valve known in the art prior to 1887. Port 35

556 cannot be opened without, at the same time, compelling the quick-action triple valve of patent 360,070 to perform the fourth function, namely, quick action. This arises from the fact that port 35 cannot be opened without at the same time opening port 42.

"4th. To exhaust air from the brake-cylinder to the atmosphere through the valve cavity 33."

This is the third function of triple valves known in the art prior to 1887, and is correctly described by Mr. Boyden, with the single exception that Mr. Boyden has denominated it as the fourth function, which it cannot be: the triple valve known in the art prior to 1887 had but three functions.

"These four valves form what is commonly known as a 'triple valve' proper, as used in the art prior to 1887."

As I have said in a previous answer, it is indistinct and indefinite to describe the features of compound valves by the number of parts, for the reason that the number of parts is independent of the num-

ber of functions. Triple valves prior to 1887 had but three functions, although they may have had two, three, four, five or any number of valves or parts.

665 Q. If, instead of interpolating his alleged third function into a statement of the functions of the appliance of patent 360,070, when acting as a triple valve proper as used in the art prior to 1887, (which alleged function, I understand from your answer, cannot be performed except when the appliance is acting as a quick-action triple valve), Mr. Boyden had recited such alleged third function as a part of the operation of the appliance of patent 360,070 when it was *not* acting as a triple valve proper as used in the art prior to 1887, to what extent would you, in such case, have agreed with him?

A. I should have agreed with him exactly, with the exception of the following sentence:

557 "These four valves form what is commonly known as a 'triple valve' proper, as used in the art prior to 1887."

In this reply I refer only to that part of Mr. Boyden's reply to Q. 6 up to the point about line 70 ending "as used in the art prior to 1887."

666 Q. In his answer to Q. 6 Mr. Boyden states (pp. 18-19) that "To apply the brakes fully with the auxiliary reservoir pressure by the final movement of the piston 12, a sufficient amount of air is gradually exhausted from the main air pipe to move the piston its full stroke. This will bring the valve port 35 coincident with the passage 22, and thereby establish communication from the auxiliary reservoir to the brake-cylinder and fully apply the brakes with the reservoir pressure."

Is, or is not, this statement of Mr. Boyden's, true and correct in fact?

A. For the reason that port 35 cannot be opened without at the same time opening port 42 and causing the performance of the fourth function, namely, that of quick action, which is the admission of train-pipe pressure into the brake-cylinder to perform a quick and nearly instantaneous application of the brakes, it is clear that Mr. Boyden's statement is incorrect. Port 35 is useful for, and has no other purpose than is connected with, the performance of the fourth function. The application of the brakes "fully with the auxiliary reservoir pressure" can only be performed by the passage 31 controlled by valve 29, and this can only take place by and with the *preliminary* traverse of the piston 12.

667 Q. To what extent do you agree with Mr. Boyden's statement in folio 75, page 19, (D. R.) as to the "essential features" of the quick-action triple valve of patent 360,070?

558 A. Mr. Boyden's answer to Q. 6 in this regard is as follows, (D. R., p. 19.)

"The essential features of the device are: 1st, the *triple valve proper*, containing sufficient valves to make it perform the triple-valve functions, and 2nd, an '*additional or auxiliary valve*' to admit the main air-pipe pressure directly to the brake-cylinder."

I cannot find the term "additional" used in the specification and

description of patent 360,070. I quote from the specification of patent 360,070, page 4, line 20:

"Whereupon the piston 12 of the triple valve is forced to the extreme limit of its stroke in the direction of the drain-cup 19, carrying with it the stem 36 and auxiliary slide-valve 41, which instantly uncovers the port 42 and discharges air from the main air pipe through the opening of the check-valve 49 and the passages 46 and 48 to the brake-cylinder, and, each car being provided with one of these devices, it will be seen that they are successively moved with great rapidity."

The term "additional," as used by Mr. Boyden, carries with it a sense of separation, whereas the term "auxiliary" applies only to the function, and does not, in any way, imply what are the number of parts, or how located, and does not give any idea of integrality. I cannot find that the inventor, in the description and specification of the device of patent 360,070, conveyed, or intended to convey, the sense of integrality or non-integrality, when referring to, and describing, the auxiliary mechanism which performs the fourth function, namely, quick action.

Mr. Boyden is right in saying that one of the essential features of the device is that it shall contain "sufficient valves to make 559 it perform the triple-valve function," and these functions are the three that I have described in a previous answer.

The other essential features cannot be described as a single one, as stated by Mr. Boyden, to wit:

"An 'additional or auxiliary valve,' to admit the main air-pipe pressure directly to the brake-cylinder,"

but should be described as follows:

First. The valve should contain sufficient parts, ports, valves and passages to enable it to perform the three triple-valve functions.

Second. The valve should contain sufficient parts, ports, valves and passages to enable the admission of train-pipe air directly to the brake-cylinder to be effected, upon the further and additional travel of the triple-valve piston, brought about by a greater reduction of the pressure in the train-pipe; the additional traverse of the piston and the reduction in the pressure in the train-pipe being greater than that used for the service application of the brakes. It matters not whether the parts, ports, valves or passages be combined in one piece, or be made up of a number of pieces, provided that the quick-action is performed in the manner I have described, namely, by the further traverse of the triple-valve piston over and above that used for service application.

Third. There should be a check-valve so located as to prevent the return of the air from the brake-cylinder to the train-pipe after the train-pipe air has entered the brake-cylinder.

These are the three essential features of the device described in patent 360,070, and, without either of these features, the quick-action triple valve would not be a practical quick-action triple valve for use in the art of braking at the present time.

In order that I may make myself clear in what I have said about quick action, I will now define what I mean by the term "quick action."

560 Quick action is the admission of air or train pipe pressure from the train-pipe to the brake-cylinder to perform two useful results, namely:

(a) The application of the brakes with greater force than can be obtained by applying them solely with full auxiliary reservoir pressure.

(b) To cause quick action to take place in the succeeding valves in a train, thus applying the succeeding brakes quickly and hastening the final application of all the brakes in the train.

In order that these useful and practical results may be obtained, it is necessary:

(a) That the air from the train-pipe to the brake-cylinder shall be admitted at once and in large quantity, so as to put a substantial amount of pressure in the brake-cylinder and produce a very substantial reduction of pressure in the train-pipe.

(b) That the passage from the auxiliary reservoir to the brake-cylinder shall be restricted, so as to prevent the early admission of a large volume of air from the auxiliary reservoir. Without this restriction, the brake-cylinder would be so completely filled with air pressure from the auxiliary reservoir, that a sufficient and substantial amount of air pressure from the train-pipe could not enter to perform the two results of quick action which I have named in this answer.

This restriction of the passage from the auxiliary reservoir to the brake-cylinder, renders it necessary that the passage from the train-pipe to the brake-cylinder shall be the larger of the two, and thus are formed differential passages, which are necessary to the practical operation of any quick-action triple valve. In the device shown in patent 360,070, the differential passages are port 42, the larger passage from the train-pipe, and port 35, the smaller passage from the auxiliary reservoir.

Fearing that I have not made the distinction between the terms "additional" and "auxiliary" sufficiently definite, I wish to add the following:

561 The term "auxiliary" does not imply location, dimension or integrality. It refers simply to the office, purpose, or function, and describes such office, purpose or function, as being one that assists or helps to perform. In this case the auxiliary action helps to apply the brakes with greater force when desired.

The terms commonly used in the description of mechanisms, to wit, "auxiliary," "supplemental," "separated," and "additional," are not synonyms. A supplemental or auxiliary device is one that assists in the performance of some function. It may, or may not, be separated, and it may, or may not, be integral.

A separated device is separate in structure, and is not integral.

The term "additional" is used both to describe integral parts having an additional function, and to describe non-integral parts which are additional, and yet have the same function, and in-

tegral parts which add to the integral structure and have the same function.

Practical examples of the application of these terms are as follows:

Adjourned to Wednesday, January 3, 1894, at 11 a. m.

NEW YORK, *January 3, 1894*—11 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of D. L. BARNES resumed:

A. to Q. 667 (continued). An example of "integral parts having an additional function" is found in the ordinary slide-valve of steam-engines. The part of the valve which controls the admission of steam from the steam chest to the cylinder, is integral with that part of the valve which controls the exhaust of the steam from the cylinder to the atmosphere. The parts are integral, but the functions are different. The function of controlling the exhaust is additional to the function of admitting the steam.

An example of "non-integral parts which are additional and yet have the same function," is found in the inlet valve for air compressors, which I have referred to in a previous answer. The considerable number of inlet valves, in that construction, are non-integral with each other, and are additional, not in function but in parts; the function of all these valves for the inlet of air to the air compressor is the same.

An example of "integral parts which add to the integral structure and have the same function," is found in multiple ported and grated valves used in steam-engines. The multiple ports and edges of the valve are combined in the same integral structure, and they are additional to each other, and they have the same function, namely, the admission of steam to the steam cylinder.

The foregoing will perhaps illustrate the wide variation in meaning which the term "additional" has, and which makes it indefinite. A device may be additional as to function, as to integral structure, or as to the number of parts, and may, or may not, be auxiliary or supplemental.

Further examples of additional, supplemental, separate, and auxiliary devices, may be found in the art of braking, as follows:

In the device described and shown in patent 360,070, valve 41 has an auxiliary function to valve 29. It is supplemental, separated, and additional. It is additional as to the number of parts, and additional as to functions.

Defendants' quick-action triple valve, catalogue 1891, is a similar example. Valve 22 has an auxiliary function to valve *i, k, j*. It is supplemental, separated, and additional. It is additional as to the number of parts, and additional as to function.

Defendants' quick-action triple valve, catalogue 1889, differs as follows: Valve 15, which corresponds in function to valve 22 of catalogue 1891, has an auxiliary function to valve

18, which corresponds in function to valve *i, j, k*, of catalogue 1891, but while it is supplemental and auxiliary, and additional in function, it is not separated and additional entirely as to the number of parts.

In conclusion then, as to the use of the term "additional" by Mr. Boyden, in the sense of being separated in structure, the term is indefinite, and I do not find it mentioned in the description of the device shown in patent 360,070, and it is not necessary, for the full performance of all the four functions of the quick-action triple valve shown in that patent, that there be any additional valve, in the sense of being separated as to structure. What is necessary is, that there shall be an auxiliary valve, (see page 4, lines 20-25, specification of patent 360,070), which shall have an auxiliary function, which shall be to perform quick action (defined as heretofore) upon the further traverse of the triple-valve piston.

It is true that in the drawing of patent 360,070, valve 41 is separated in structure, and therefore additional as to the number of parts, but this is immaterial, for the same essential characteristic feature and function of the device will be performed, in precisely the same way, if valve 41 was combined with, and was integral in structure with, slide-valve 14. The construction, as shown, is better, for some reasons, to use in practical braking, but an integral device, such as I have described, would do the work and perform the same useful result, namely, quick action, in the same way.

Again, for all the purposes of performing the fourth function of quick-action triple valves, valve 41 might be rigidly attached to stem 45, and these together rigidly attached to piston 12, and the device would then be an operative quick-action triple valve, which would perform the fourth and auxiliary function, in the same useful way as the device shown in patent 360,070.

564 Again, the device just described might be more integral by being attached to valve 14, and then, by the removal of valve 29, which would then become unnecessary, this more integral device would perform the fourth function of a quick-action triple valve, in the same way as before.

An actual example of a construction of this kind is found in defendants' quick-action triple valve, catalogue 1889. In that valve the auxiliary valve 15 is integral with the piston 12, and is not additional as to structure, and yet it performs the fourth function of quick-action triple valves, in the same useful way as the device shown in defendants' 1891 catalogue and in the drawings of patent 360,070, in both of which last mentioned, the part which performs the auxiliary or fourth function, namely, valves 22 and 41, are non-integral, and therefore additional as to the number of parts.

From the fact that the part which performs the fourth function of quick action triple valves, in the three valves last mentioned, namely: the device shown in the drawing of patent 360,070, in defendants' 1891 catalogue, and in defendants' 1889 catalogue, is, in some cases, separated and non-integral, and in other cases is integral, it is clear that, because these devices all perform the auxiliary function, and are therefore auxiliary, the term "additional," in the

sense of being separated as to structure, should not be used for the description of the essential features and characteristics of the device shown and described in patent 360,070.

To sum up then as to the essential characteristics of the quick-action triple valve described in the specification of patent 360,070:

There must be sufficient parts, ports, valves and passages, integral or non-integral, to enable the performance of the three functions of plain triple valves.

There must be sufficient parts, ports, valve- and passages, integral or non-integral, to enable the performance of the auxiliary or fourth function, namely, quick action, of quick-action triple valves, upon the further traverse of the triple-valve piston over and above
565 that traverse which is used for the three functions of plain triple valves.

There must be a check-valve, so located, or a device of a similar nature, so arranged, that the air from the train-pipe, after having once entered the brake-cylinder will be retained there.

Counsel for defendants objects to all that part of the last answer in which the witness volunteered the statement and illustrations of his own peculiar views of the different meanings of certain words, as irrelevant and improper.

The said part referred to in the answer is further objectionable because it is not evidence, but is a mere argument volunteered by the witness.

Counsel further objects because some of the words, the meaning whereof he assumes to discuss, were not used by Mr. Boyden in the statement inquired about in the question, and that part of the answer therefore, is not proper in rebuttal.

Counsel further objects to testimony of this kind, because the witness is testifying relative to a patent which has definite limitations and restrictions in all the claims, as to which he is requested to pay no regard, and yet he seeks to expound the specification of that patent, and the structures therein described, in manifest and utter disregard of the said limitations and restrictions in the claims. This testimony therefore is improper.

Counsel for complainants is pleased to see that defendants' counsel correctly understands the purpose of the testimony of this witness, which is that of a mechanical engineer and not of a lawyer, but inasmuch as the claims of the patent in question, and the limitations, if any, which they contain, are matters of law, and not proper for
566 discussion by this witness, counsel for complainants confesses himself unable to see any impropriety in the witness having abstained from a discussion of them.

568 Q. To what extent do you agree with Mr. Boyden's statement in folio 82, page 21 (D. R.), as to the "essential features" of defendants' quick-action triple valve, plate XI 1891 catalogue?

A. Before making a concise reply to this question, I shall describe the valve, as to structure and operation, in order that my answer may be definite and clear.

In the defendants' quick-action triple valves, catalogues 1889 and

1891, there is a piston operated by variations in pressure in the train-pipe, the operating power being the momentary or continuous differential pressure on the opposite sides of the piston, just as is the case with all triple valves, quick action or plain, with which I am familiar.

This piston operates a valve which performs the three triple-valve functions used in the art prior to 1887.

A further traverse of the triple-valve piston, over and above that necessary to perform the three triple-valve functions just referred to, operates to perform the fourth function, namely, the quick action of the quick-action triple valves.

The defendants' quick-action triple valve is provided, like all other quick-action and plain triple valves, with the differential passages necessary to permit the momentary or continuous differential pressures, which are, and always have been, necessary to the operation of plain or quick-action triple valves so far as I know.

Defendants' quick-action triple valve is provided with a check-valve, which prevents the return of air pressure to the train-pipe from the brake-cylinder after it has once entered that cylinder from the train-pipe.

Mr. Boyden's description of the essential features of defendants' quick-action triple valve is limited, but correct.

567 It is correct in that the triple-valve functions, common in the art prior to 1887, which he has described as the functions of "*the triple valve proper*," are essentials.

It is correct in that he has dominated "*the differential passages*" as essentials, which they are as I have described in a previous answer, and not only are they essentials to defendants' quick-action triple valve, but likewise are they essentials, and similarly do they exist, in all other quick-action triple valves with which I am familiar.

Mr. Boyden's answer is limited, in that it does not describe the primary essentials of the defendants' quick-action triple valve. These primary essentials, in addition to the other primary essentials, which Mr. Boyden has properly described, namely, the functions of "*the triple valve proper*," are as follows:

Sufficient parts, valves, ports and passages to enable the performance of the auxiliary or fourth function of quick-action triple valve by the further traverse of the piston of the triple valve, brought about by a further reduction of pressure in the train-pipe, both the said traverse and the further reduction being over and above that necessary to perform the three functions of the "*triple valve proper*," and further:

The essential check-valve which will prevent the return of pressure from the brake-cylinder to the train-pipe after it has entered from the train-pipe.

Having answered this question, I wish to explain further my answer to the previous question in that part referring to the meaning which is implied to me by Mr. Boyden's use of the term "additional." I have said that I have read Mr. Boyden's testimony in this case, and I now quote from (D. R.) page 30, folios 117-118:

"This distinctly shows that the complainants' device uses two valves to perform the quick application of the brakes, one of which belongs to the *triple valve proper* while the other is an auxiliary valve additional to the triple-valve structure."

568 From this I have been led to infer that Mr. Boyden used the term "additional," in the sense of being separated, as being an essential feature or characteristic of the device described in the specification of patent 360,070.

669 Q. Please state briefly what you understand to be the "essential features" of defendants' quick-action triple valve, plate IX defendants' 1889 catalogue, so far as the same may differ, if at all, from those of the structure of plate XI defendants' 1891 catalogue as indicated in your last preceding answer?

A. The description I have given of the essential features of defendants' quick-action triple valve, 1891 catalogue, applies with equal force, and without limitation, to the quick-action triple valve of defendants' 1889 catalogue.

670 Q. As a practical expert in quick-action automatic brakes, state to what extent you find the essential features of practical operation of defendants' quick-action triple valve (plate IX defendants' 1889 catalogue, and plate XI defendants' 1891 catalogue) to be in correspondence with those of the quick-action triple valve of patent 360,070?

A. In each of the three triple valves, there is a piston which is operated by momentary or continuous differential pressures, and which has two distinct traverses. The first traverse operates a set of parts, ports, and passages which perform the three functions of triple valves known in the art prior to 1887.

The second, or further, traverse, of the triple-valve piston, operates a set of parts, ports, and passages which perform the auxiliary or fourth function of quick-action triple valves, namely, quick action.

In each of the three triple valves there are differential passages, which render momentary or continuous differential pressures possible, and there are differential passages which restrict the flow of air from the auxiliary reservoir to the brake-cylinder, to prevent the filling of the brake-cylinder quickly by air from the auxiliary reservoir, and permit the quick filling of the
569 brake-cylinder by air from the train-pipe, through the much larger passage, for the performance of quick action. The passage from the train-pipe to the brake-cylinder is, in all three valves, enormously larger than the passage from the auxiliary reservoir to the brake-cylinder, for the sole purpose of rendering quick action possible.

In each of the three valves there is a check-valve, so located as to prevent the return of the air that has passed into the brake-cylinder from the train-pipe, to the train-pipe.

In each of the three valves, the further traverse of the piston, before mentioned, opens an auxiliary valve and permits the air from the train-pipe to flow through a large passage from the train-pipe to the brake-cylinder to produce quick action.

I have referred to the wide difference in the size of the differential passages used in triple valves, and more especially in quick-action triple valves, for the reason that quick action is dependent not upon the mere passage *per se*, of air from the train-pipe to the brake-cylinder, for this does not necessarily give quick action. Quick action is only possible when the passage from the auxiliary reservoir to the brake-cylinder is restricted (and thereby made differential with respect to the passage from the train-pipe to the brake-cylinder), so much as to prevent the flow of air pressure from the auxiliary reservoir to the brake-cylinder, in a sufficient quantity to suffocate and suppress a very material and substantial and rapid and early flow of air pressure from the train-pipe to the brake-cylinder, in such a way as to perform the three useful results of quick action, namely :

(a) To apply the brakes with greater force than they can be applied with auxiliary reservoir pressure.

(b) To so quickly and substantially reduce the pressure in the train-pipe as to cause the succeeding triple valves in the train to apply with quick action.

570 (c) To economize the air pressure stored in the brake system.

A more specific and detailed comparison of these three quick-action triple valves is as follows :

In order to shorten the following comparison I will refer to the three quick-action triple valves as follows :

Complainants' quick-action triple valve, shown and described in patent 360,070, I will denominate complainants' valve.

Defendants' quick-action triple valve, plate IX, 1889 catalogue, I will denominate defendants' 1889 valve.

Defendants' quick-action triple valve, plate XI, 1891 catalogue, I will denominate defendants' 1891 valve.

In each there is a triple-valve piston, having two distinct traverses, one traverse being an extension of the other, as follows : Piston 12, complainants' valve ; piston 5, defendants' 1889 valve ; piston 29, defendants' 1891 valve.

In each there is a combination of parts, valves and passages which perform, during the preliminary traverse of the triple-valve piston, the three functions of triple valves known in the art prior to 1887, as follows :

Stem 13, valve 14, valve 29, passage 31, cavity 33, complainants' valve.

Stem 13, stem 17, valve 18, valve 13 of defendants' 1889 valve.

Valve and stem 18, and the passages to that stem, and valve 17 of defendants' 1891 valve.

The foregoing parts perform the same function in each of the valves, and are actuated in the same way, namely, by the preliminary traverse of the piston, and, as they perform the same function, I shall denominate these parts as being those that perform the same function, and which have been described by other witnesses in this case, as I learn from reading the testimony with reference to complainants' valve, namely, the main valve functions.

There is a difference in the structure of the valves, as follows:

571 Valve 14 of complainants' valve is what is known as a slide-valve, while its equivalent, (valve 18) in defendants' 1891 valve, is a piston valve. The difference in structure does not give a difference in function. In the mechanical arts, piston valves and slide-valves are used interchangeably.

In each there are differential passages as follows:

The smaller 35 and the larger 42 of complainants' valve; the smaller passage *e* and the larger passage, that uncovered by valve 15, of defendants' 1889 valve; the smaller passage B, and the larger, that uncovered by valve 22, of defendants' 1891 valve.

In each the further traverse of the piston moves an auxiliary valve which opens the larger of the differential passages to the brake-cylinder from the train-pipe, as follows:

Valve 41 and passage 42, of complainants' valve; valve 15 and the passage which it opens, of defendants' 1889 valve; valve 22 and the passage which it opens, of defendants' 1891 valve.

In each, there is a check-valve which prevents the return of the air in the brake-cylinder to the train-pipe, as follows:

Check-valve 49, of complainants' valve; check-valve 11, of defendants' 1889 valve; and check-valve 26, of defendants' 1891 valve.

In complainants' valve and in defendants' 1891 valve, the auxiliary valves for the performance of the quick-action function are shown in the drawings to be non-integral with the piston, and do not move during the preliminary traverse of the piston, but in defendants' 1889 valve, the auxiliary valve for performing the quick-action function is integral with the piston. But, as I have said before, it is my opinion that this difference is immaterial. What is essential is, that the auxiliary valve for the performance of the auxiliary or fourth function of quick-action triple valves, shall be operated to perform that function, upon the further traverse of the triple-valve piston.

572 671 Q. In your last preceding answer, you have recited a number of essential features of practical operation of the defendants' 1889 and 1891 quick-action triple valves, which are in correspondence with those of the quick-action triple valve of patent 360,070.

Are we to understand that the features which you have named are *all* the essential features, which, in your opinion, exist in the several valves, and if not, what others are there, and are such others, if any, in correspondence or not?

A. I have described all the essential features of the three valves for the performance of the function of quick-action triple valves. Such other differences as exist are structural differences, which do not affect the practical operation of the valves.

672 Q. In his answer to Q. 12, defendants' witness J. B. Church alleges that there is a difference "in principle or mode of operation" between the device of patent 360,070 and the defendants' device.

Inasmuch as it appears from the cross-examination of Mr. Church

that he has had neither a practical mechanical training nor a technical education, and testifies on the basis of his reading and studying in the Patent Office, it seems desirable, for the enlightenment of the court, that the opinions and theories he enunciates should be tested, as to their correctness, by one who is able to approach the subject from a *practical* standpoint.

To this end, please state whether the above-referred-to assertion of Mr. Church is correct or well founded, and if it is not, state what you, as a mechanical engineer familiar with air-brake practice, understand to be the "principle" or "mode of operation" of the appliance of patent 360,070, and state in what, if any, particular, either of "principle" or "mode of operation" the defendants' quick-action triple valves differ from the appliance of patent 360,070?

A. Mr. Church says:

"The patentee, Mr. Westinghouse, took the old-fashioned
573 valve, contrived *an additional valve element*, and compelled the triple valve to actuate this additional valve element so that the latter would admit train-pipe air to the brake-cylinder under certain conditions."

This statement is incorrect in the use of the indefinite term "additional," and is limited very much by the use of the words, "under certain conditions."

A true statement of facts is as follows:

Mr. Westinghouse added to the triple valves in use prior to 1887, not an "*additional valve element*," but an additional function, namely, that of quick action, not the mere admission, *per se*, of train pipe air to the brake-cylinder, but the admission of train-pipe air to the brake-cylinder in such a manner as to perform quick action. In a preceding answer, I have tried to set forth the difference between the admission, *per se*, of air to the brake-cylinder from the train-pipe, and the admission in a manner which will perform quick action. The difference is distinct and marked; one produces a practical and useful result in the art of braking, namely, that of quick action, while the mere admission, *per se*, of air to the brake-cylinder does not necessarily produce any useful result. In fact, the admission of air from the train-pipe to the brake-cylinder, as done prior to 1887, did not produce a useful result, and such admission was not used, to my knowledge, to any extent in practical braking. As an example of the admission of air from the train-pipe to the brake-cylinder which will not produce quick action, and which will not produce a useful result, I will cite the device shown in patent No. 280,285, the operation of which is as follows, (see Fig. 3, patent granted to C. A. Boyden, June 26, 1883):

The auxiliary reservoir and the train-pipe, and the cavity L, which acts as a supplemental auxiliary reservoir, having been charged with, say, 70 pounds pressure, a reduction in the train-pipe pressure is not followed by a corresponding reduction in pressure in the reservoir L, owing to the presence of a check-valve
574 *d*¹, which prevents a return of air through that charging valve to the train-pipe. Therefore, there is established a differential pressure, and the piston I moves downward and opens

the passage C' to the brake-cylinder. Air then flows from the auxiliary reservoir to the brake-cylinder, through the passages R', C', until the pressure is reduced in the auxiliary reservoir, and in the triple-valve cavity, below what it is in the train-pipe. Then air passes from the train-pipe, through the charging valve d', into the triple-valve cavity, thence to the auxiliary reservoir through the passage R, and to the brake-cylinder through the passage C', until an equilibrium is established. There may be a slight difference, at the termination of this action, between the pressure in the auxiliary reservoir and the brake-cylinder and the train-pipe, owing to the presence of a small spring d' above the check-valve.

The inventor describes the purpose of this admission of air from the train-pipe to the brake-cylinder as follows:

"My invention consists, first, in the several combinations, herein-after specified, with an air reservoir on the car, of means whereby the said air reservoir may be replenished or recharged with compressed air while the passages or ports leading therefrom from the brake-cylinder are open and while the brakes are applied."

"Fourth, in a new method of applying and maintaining the application of the brakes through a single line of train-pipe."

There may be other examples in the art, but I have cited this as a good illustration of how air pressure may be taken from the train-pipe, and admitted to the brake-cylinder, without producing quick action, or, in fact, any useful result whatsoever. The non-utility of the device shown in patent No. 280,285 appears to me from
575 the fact that I do not see any means provided for graduation, or that would produce a practical control of the amount of the pressure in the brake-cylinders.

Therefore, Mr. Church is not only limiting the improvement in the art of braking devised by Mr. Westinghouse, but he is incorrect in using the indefinite term "additional," when the specification of patent 360,070 distinctly uses the term "auxiliary." It is practically incorrect to omit to state the entire fact.

Mr. Church says:

"On the other hand, Mr. Boyden, the inventor of the defendants' device, took the form of the old-fashioned triple valve, which had a check-valved feed-passage, and by simply separating the piston chamber from the valve chamber and restricting the passage through which air flows from the auxiliary reservoir to the valve chamber, he introduced the new principle of 'momentary differential air pressures,' and thereby compelled the *triple valve itself* to admit train-pipe air to the brake-cylinder without the aid of any auxiliary-valve element whatever."

In the last sentence of the preceding quotation Mr. Church has used the correct term for describing the improvement devised by Mr. Westinghouse in the matter of construction, namely, the "auxiliary-valve element."

It is of course impossible for me to determine what Mr. Boyden "took" to form the defendants' triple valves; I can only understand what has been done, and that I find in the result of Mr. Boyden's work, namely, the defendants' triple valves. It is wholly un-

safe for me to reason, or any one else for that matter, on the steps taken in development, and I will confine myself wholly to the results.

In defendants' 1889 and 1891 valves, I find what Mr. Church has described as a "check-valve" passage. But it is not essentially a

576 "feed-passage." It is a large and substantial passage, altogether too capacious for feeding purposes. I find it to be, primarily, for the purpose of admitting air from the train-pipe to the brake-cylinder, and the check-valve to be for the purpose of preventing the return of that air. Manifestly, passage F is all out of proportion to passage B, through which the air must flow to reach the auxiliary reservoir. Passage B would control the amount of air fed to the auxiliary reservoir, not valve 26 of defendants' 1891 valve.

The separation of the piston chamber from the valve chamber is not clear to me. The separation is not complete. A ring has been provided which acts, during quick action, as a restriction to the passage of air from the auxiliary reservoir to the brake-cylinder, but during the performance of the three triple-valve functions, there is practically no restriction brought about by this ring, and it might, for all intents and purposes of practical operation, be removed.

To be more specific, the ring that I have referred to is No. 9 of defendants' 1891 valve, and there is a similar ring in the 1889 valve. The passage B, 1891 valve, is so much larger than the passage to the brake-cylinder through the valve 18, that the air supply to the passage B, during the performance of the three triple-valve functions, is more than could pass through the passage to the brake-cylinder in valve 18, and, therefore, the ring 9 performs no useful purpose, during the operation of the quick-action triple valve as a plain triple valve prior to 1887. This I have found by experiment.

Although the passage B in the 1891 valve is larger than the passage to the brake-cylinder through valve 18, yet it is noticeable that the corresponding passage *e* of the 1889 valve is considerably smaller than the passage to the brake-cylinder controlled by valve 13. It is clear then, that the passage controlled by valve 13 to the brake-cylinder is more than ample to transmit all of the air that can pass from the auxiliary reservoir to the brake-cylinder through the passage *e* of defendants' 1889 valve.

577 The separation of the piston chamber from the valve chamber, in defendants' valve is, therefore, of no value to assist in performing the three triple-valve functions, but is of value to assist in performing the fourth, or quick-action, function, as it establishes a restricted passage, corresponding to the restricted passage 35 of patent 360,070, between the auxiliary reservoir and the brake-cylinder, which is provided in order to render quick action a possibility, as I have described in a preceding answer.

Adjourned to Thursday, January 4, 1894, at 11 a. m.

NEW YORK, January 4, 1894—11 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of D. L. BARNES resumed:

(A. to Q. 672 continued.) The restricted passage 35 of complainants' valve, and the restricted passage *e*, of defendants' 1889 valve, and B, of defendants' 1891 valve, are identical in purpose and function.

The large passage 42, of complainants' valve, and the large passages uncovered by valve 15, of defendants' 1889 valve, and valve 22, of defendants' 1891 valve, are identical in purpose and function.

The passages just described form the essential differential passages. Passage A, of defendants' 1891 valve, and passage *b*, of defendants' 1889 valve, are not passages which require any specific differential from passages B, (*e*). It is only necessary that the passages A (*b*) shall be large enough to furnish an ample supply of air, back of the triple-valve piston, just as is the case with complainants' valve, where a sufficient volume of reservoir air passes through the passage at the centre of the valve, on the left in figure 2.

578 Restricted passages for the purpose of producing "momentary" or continuous differential pressure are very old in the art of braking. Manifestly, if all the passages leading into and out of a valve were of the same size and capacity, it would be impossible to produce a momentary or continuous differential pressure. An example of restricted passages for the purpose of producing momentary differential pressures is found in several early patents for triple valves. For instance, patent No. 168,359, granted to George Westinghouse, Jr., October 5, 1875. There is a large passage R, figure 1, leading from the reservoir to the back of the triple-valve piston, and a small passage *s*, leading from the back of the triple-valve piston to the front or train-pipe side. These passages are differential in size, the passage *s* being restricted to give a differential pressure on opposite sides of the piston. Upon a substantial reduction of pressure in the train-pipe, the pressure on the train-pipe side of the piston is reduced, while the pressure on the opposite sides of the piston is maintained by an abundant supply of air through the large hole R, and is restricted from quickly increasing the pressure on the train-pipe side of the piston through the restricted passage *s*, because of the differential size of the passages *s* and R. This gives, therefore, a differential momentary or continuous pressure on the opposite sides of the piston, for the purpose of operating the piston.

Mr. Church is entirely wrong in saying, that Mr. Boyden has introduced the "new principle of momentary differential air pressure." The principle is very old in the art.

Mr. Church is not right in intimating that the check-valved feed-passage remains in defendants' 1891 valve, as a feed-passage, *per se*, as the only relation it bears to a feed-passage, in the present construction, is that the feed passes through it, and is not controlled by it. It has been found necessary, in practical operation, to con-

579 trol the feed or charging process by small grooves in the stem of piston 29, the area of these grooves being exceedingly small, probably about one two-hundredths part of the area of the passage F, defendants' 1891 valve, which Mr. Church has intimated is a "check-valved feed-passage."

Mr. Church omitted to say that the passage F, which I understand he has termed the "check-valved feed-passage," has its main and only practical purpose and function in admitting train-pipe air to the passage uncovered by valve 22, upon the further traverse of the piston.

Mr. Church says that Mr. Boyden "compelled the *triple valve itself* to admit train-pipe air to the brake-cylinder without the aid of any auxiliary-valve element whatever."

In this Mr. Church is entirely wrong, for two reasons, as follows:

(a) Auxiliary-valve elements are added, namely, restricted passage B, valve 22 and valve 26.

I understand the term "auxiliary-valve element" to mean any element which goes to make up a valve, whether it be a port, a passage, a valve, a piston, or a function, or office.

(b) If, in any piece of mechanism, the parts be rearranged, enlarged, reduced, changed, separated, or made more integral, so that one part performs the office of two or more others, such change adds a valve element or function, if another function or office is performed. It does not decrease the number of functions of a mechanism if the individual parts are combined in a different way, or combined to make a less number of parts, provided the same functions are performed.

I cannot find a single function that is performed by the complainants' valve, that is not also performed by the defendants' valves, and furthermore, they are performed in substantially the same way. In this conclusion I am upheld by the statement in defendants' catalogue 1891 (p. 29), which sets forth the operation of defendants' valve as follows:

580 "The actions of this valve in graduating, full-service application, quick action and the release, are the same as the new Westinghouse quick-action valve, thereby producing the same results in braking, which renders cars equipped with the two valves perfectly interchangeable—the hose couplings being the same."

Mr. Church says:

"In admitting train-pipe air to the brake cylinder the device of Mr. Westinghouse acts on the mechanical principle of employing the triple-valve piston to actuate a new and additional valve element to open the passage from the train-pipe to the brake-cylinder: whereas, the device of Mr. Boyden acts on the entirely different mechanical principle of employing *differential air pressures* to actuate, not a new and additional valve element, but the *triple valve itself*, to open the passage from the train-pipe to the brake-cylinder."

Mr. Church is wrong in this statement, for the specification of patent 360,070 distinctly defines the new principle devised by Mr. Westinghouse, which is the employment of the further traverse of the triple-valve piston to actuate an auxiliary valve, which may, or

may not, be a part and parcel, or integral with, any other valve or part, but what it must be is, auxiliary in its function. The term "additional" used by Mr. Church is unwarranted.

Mr. Church is wrong in saying that the defendants' valves operate on the "entirely different mechanical principle of employing differential air pressures," for the reason that this is not a different principle from what has been employed in triple valves from the beginning of their use so far as I know. Without "differential air pressures," the complainants' valve could not operate either as a triple valve prior to 1887, or as a quick-action triple valve. I have found, from actual experience, that one of the most important features to provide for, in designing plain triples or quick-action triple valves, is the "differential air pressures," which Mr. Church has called a "different mechanical principle." The whole foundation of useful practical operation of quick-action triple valves rests on the possibility of obtaining the necessary differential air pressures.

Mr. Church says that Mr. Boyden uses "the triple valve itself, to open the passage from the train-pipe to the brake-cylinder." This is not new, and is exactly what is done in complainants' valve. The triple-valve piston is a part of "the triple valve itself," and it is the further traverse of this piston which is used, in both the complainants' and defendants' valves, "to open the passage from the train-pipe to the brake-cylinder."

Mr. Church says:

"Mr. Westinghouse uses a new and auxiliary valve, not a part of the triple valve. Mr. Boyden utilizes the feed-valve of the old triple valve."

Mr. Church is wrong in this, because the specification of patent 360,070 in no way refers to the necessary use of a "new and auxiliary valve, not a part of the triple valve." Mr. Westinghouse devised a quick-action triple valve not known in the art prior to 1887, in which there is an *auxiliary* valve operated by the further traverse of the piston, which *auxiliary* valve may, or may not, be a part and parcel with any other part of any triple-valve construction known prior to 1887, but what it must have is, the *auxiliary function* of admitting air from the train-pipe to the brake-cylinder, upon a further traverse of the triple-valve piston.

Mr. Church is wrong in saying that "Mr. Boyden utilizes the feed-valve of the old triple valve," for any such purpose as Mr. Westinghouse has used the auxiliary valve. Mr. Westinghouse's auxiliary valve performs the auxiliary function of admitting air from the train-pipe to the brake-cylinder, which is an entirely different operation from that performed by the feed-valve in the present construction of defendants' valves. The feed-valve, or that part which controls the feed, is an exceedingly small groove in the piston stem, and this feed valve or groove admits air from the train-pipe to the auxiliary reservoir, which is an entirely different operation.

In the preceding portion of this answer, I have cited an example (namely, G. A. Boyden, patent No. 280,285, June 26, 1883), of a

triple valve having a passage from the train-pipe to the brake-cylinder, which performs no useful purpose in the application of the brakes by train-pipe pressure. That triple valve has "a check-valved feed-passage" of the kind that I understand Mr. Church refers to, but if this is what he means, I cannot see the logic which leads him to intimate that defendants' 1889 and 1891 valves are the same in any essential feature, either in construction or in operation, but of course I can understand that, in the light of the development of the art shown in the drawings and specification of patent 360,070, an intelligent mechanic might change, alter, and develop a device like that shown in patent No. 280,285, using at the same time the experience obtained in the art with plain triple valves prior to 1887, to such an extent as to make a quick-action valve, but, as the device shown in patent No. 280,285 is not a practical and useful plain triple valve, and has no essential element of a quick-action triple valve, it is evident that the changes necessary to produce a quick-action triple valve operating practically like complainants' valve, as claimed in defendants' 1891 catalogue, page 29, from which I have quoted, would be sweeping and would produce an entirely different structure, producing entirely different results. And this I find to be the case when I compare defendants' 1889 and 1891 valves with defendants' valve shown in patent No. 280,285.

If this is the sort of comparison that Mr. Church intends 583 to make when he says that "Mr. Boyden utilizes the feed-valve of the old triple valve," then he is entirely wrong and illogical.

Mr. Church says:

"Mr. Westinghouse actuates his new valve by the impact of the triple-valve piston."

But Mr. Church omits to say that the defendants actuate their new valve for producing the auxiliary or fourth function, by the impact of the piston, in precisely the same way, and upon the further traverse of that piston.

To be more specific, the impact of the collar on the piston stem of defendants' valves is what lifts or opens the auxiliary valve 22 and performs the fourth function, namely, quick action.

Mr. Church says that

"Mr. Boyden actuates the old feed-valve, such as that of his 1883 patent, by the differential air pressures momentarily established in the triple-valve chamber."

I do not see what this statement has to do with the case in point, as the old feed-valve of the "1883 patent" is not present in the construction of defendants' valves. I do find there present a check-valve through which the feed of air passes, but that check-valve is not used for the purpose, at the present time, of controlling the feed in defendants' valves, but is used for, and finds its main usefulness in, preventing the return of air to the train-pipe from the brake-cylinder after the train-pipe air has passed to the brake-cylinder.

Mr. Church is wrong in intimating that there is anything new in the art, in operating check-valves to assist in quick-action, or feed-check valves to control the charging process, by the "differential

pressures momentarily established in the triple-valve chamber," for the reasons which I will now recite:

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In patent No. 280,285, to which I have before referred, the feed-check valve is operated like all other "check" valves with which I am familiar, by differential pressures, and, in this case, by "the differential air pressures momentarily established in the triple-valve chamber."

In a preceding answer I have called attention to the fact that the passage B (c) has no office or usefulness except in the performance of quick action. This statement has an important bearing, in this way. When valve 22 (15) is opened, the pressure in the cavity C of the 1891 valve, and the corresponding cavity in the 1889 valve, becomes the same as that in the brake-cylinder for the moment, and for all purposes of practical operation, that cavity, namely, C, during quick action, might just as well be a part of the cylinder, and is, in fact, a part of the cylinder cavity, for all the purposes of quick action. Bearing this in mind, it is seen that as soon as valve 22 (15) is opened, the pressure in cavity C is identical with that in the brake-cylinder.

Hence, the momentary condition at the commencement of quick action, with respect to check-valve 26, which is a check-valve of the kind now being considered, is as follows:

On the brake-cylinder side there is brake-cylinder pressure, which is practically atmospheric pressure, and on the train-pipe side there is train pipe pressure; hence there is established a momentary differential pressure between the brake-cylinder pressure and the train-pipe pressure, which opens check-valve 26.

An exactly parallel case is found prior in the art in the case of complainants' valve, patent 360,070 to which I now refer, Figs. 2 and 4. At the commencement of quick action, check-valve 49 is exposed on one side to brake-cylinder pressure, and on the other side to train-pipe pressure, for reasons that are perfectly clear from the construction. Hence the momentary conditions at the

585 commencement of quick action, with respect to check-valve 49, which is a check-valve of the kind now being considered, are as follows:

On the brake-cylinder side, there is brake-cylinder pressure, which is practically atmospheric pressure, and, on the train-pipe side, there is train-pipe pressure; hence there is established a momentary differential pressure between the brake-cylinder pressure and the train-pipe pressure, which opens check-valve 49, in precisely the same way as check-valve 26 is opened in defendants' valves.

It is misleading and indefinite to refer to "triple-valve chambers" as Mr. Church has done, for the reason that there are, and may be, several triple-valve chambers, which may be confused with each other. For instance, if we should compare triple-valve chambers like other details of compound valves, on the basis of their function, and distinguish these functions by the pressures contained in the triple-valve chambers at coincident times, we should find some of the chambers having different functions at

different times, which lead to confusion. For instance, in complainants' triple valve of patent 360,070, the chamber below the piston 12 has practically the same pressures at coincident times, as the chamber below piston 29 of defendants' valves.

The chamber above piston 12, of complainants' valve of patent 360,070, has practically the same pressures at coincident times as the chamber above piston 29, and between it and the passage B, of defendants' valves.

In defendants' valves, there is a chamber C which has a wide variation in pressure therein, and, at one time, is practically a part of the brake-cylinder cavity, by reason of the opening of the large passage by valve 22, which is the case during and after quick action has taken place, while, at another time, namely, during the performance of the three triple-valve functions, the passage B becomes *nil*, for all practical purposes, and the cavity C is then
586 practically a part of the auxiliary reservoir. Thus the cavity C alternates, from being a part of the brake-cylinder during and after quick action has taken place, to being a part of the auxiliary reservoir cavity during the performance of the three triple-valve functions.

There is no "*the*" triple-valve cavity, *per se*, which is sufficiently definite to make a comparison based on such a "*the*" cavity safe for reaching two conclusions.

In this case, the question involved is, what actuates the check-valve which prevents the return of train-pipe air to the train pipe after it has passed to the brake-cylinder. Clearly it is, as I have shown, that it is accomplished "by the differential air pressure momentarily established" (not in *the triple-valve chamber*) between the brake-cylinder pressure on one side of the check-valve, and the train-pipe pressure on the other side.

Mr. Church says:

"Suppress the auxiliary valve 41, and the port 42 of the Westinghouse device, and there can be no quick action nor admission of the train-pipe air directly into the brake-cylinder, although the triple valve will, in other respects, act as before; suppress the partition 9 in the Boyden device, and there can be no quick action nor admission of train-pipe air directly into the brake-cylinder, although the triple valve will, in all other respects, act as before."

This much of Mr. Church's statement about suppression of parts is true, as it is a statement of fact, but he might have added that there are many other parts which, if suppressed, would result in destroying quick action, but, although the suppression of any one of several of the parts of the two valves being considered, would destroy quick action, thus producing the same practical result, the production of the same practical result does not make them equivalent.

A practical example might be found in the case of a window
587 pane; a brick and a bootjack will both break window panes and thereby produce the same result, but this does not prove

that a brick is equivalent, or the same thing as, or that it has the same functions as, a bootjack.

Mr. Church is entirely wrong in drawing a comparison between the office and function of devices, simply because the suppression of them will produce a sweeping destructive result. Take the case in point; Mr. Church says:

"In the one case (Westinghouse device), therefore, the auxiliary valve 41 and its port 42 constitute the quick-action device as distinguished from the old triple valve; in the other case (Boyden device), the partition 9 and its restricted passage *c* (or B) constitute the quick-action device as distinguished from the old triple valve."

The error in such a comparison I will now point out by an example from the two devices in question, in which I will make a comparison between two parts, the suppression of which will destroy quick action, and yet which are manifestly not the equivalents of each other in any respect.

I will assume that the small projection on the bottom of piston 12 of complainants' device be removed or suppressed, and that the auxiliary valve 22 of defendants' device be removed or suppressed. In both cases quick action will be destroyed, but, manifestly, the hub on the piston 12 is not the equivalent of the auxiliary valve 22, which shows the illogical comparison used by Mr. Church to prove the equivalence of devices in the valves in question.

I will now make a comparison that is more logical, following Mr. Church's plan of suppression otherwise, but in this comparison I shall suppress equivalent devices, and not non-equivalent.

If the valve 41 and passage 42, of complainants' device, and valve 22 of defendants' device, and the passage which it controls be suppressed; quick action will be destroyed, and the devices are equivalent, *because there will then be no passage of ample size from the train-pipe to the brake-cylinder and no auxiliary valve to open such passage upon the further traverse of the triple-valve piston.*

I will assume that the partition 9, and its restricted passage *c* (or B) of defendants' valve, and the restricted passage 35 of complainants' valve be suppressed; quick action will be destroyed and the devices are equivalent, *because there will then be no restricted passage between the auxiliary reservoir and the brake-cylinder to prevent the auxiliary reservoir pressure from quickly filling the brake-cylinder, thus reducing the amount of air which can enter from the train-pipe below a point where quick action will be produced.*

If the check-valve 49 of complainants' valve, and the check-valve 26 of defendants' valves be suppressed, quick action will be destroyed *because there will then be no "check" to the return of air from the brake-cylinder to the train-pipe; thus the practical effect and useful result of quick action will be lost.*

If the further traverse of the piston 12 of complainants' device, and the further traverse of piston 29 of defendants' device be suppressed, there would be no quick action *because there would then be nothing to operate and actuate the auxiliary valves (41 and 22 respect-*

ively) which open the passage directly from the train-pipe to the brake-cylinder to perform the auxiliary or fourth function.

If the "impact" of the triple-valve piston 12, through its hub, on the auxiliary-valve device of complainants' valve, and the impact of the triple-valve piston 29, through the collar on its stem, be suppressed, there would then be no quick action *because there would then be no means of actuating the auxiliary-valve devices upon the further traverse of the piston.*

The foregoing comparisons are logical, for the reason that the causes which, in each case, destroy the quick action, are shown to be the same in both. In omitting to give the causes which
589 lead to the identical result, Mr. Church has been led into making comparisons between devices that do not perform the same function, and are therefore incomparable.

The error in the following statement by Mr. Church, is too apparent to need further explanation than that I have already given. He reasoned to the conclusion that the devices have a "difference of principle" which is fundamental, and "completely distinguishing" the one from the other; that they have "no common analogy or resemblance;" that it is "necessary to assign the two inventions to entirely different classes or categories when looked at from a mechanical point of view."

In this Mr. Church is wholly wrong. The devices differ only structurally, and not at all functionally, and not at all in the methods employed to perform the functions.

To sum up, and state concisely what I have said at more length in answer to this question, I now say the following:

1st. Mr. Church's statement is not correct or well founded.

2d. The "principle" or "mode of operation" of the appliance of patent 360,070 is as follows:

(a) The performance of the three triple-valve functions common in the art prior to 1887.

(b) The admission of train-pipe pressure from the train-pipe to the brake-cylinder, brought about by the further traverse of the triple-valve piston, which actuates an auxiliary valve to perform the auxiliary or fourth or quick-action function, which auxiliary valve may be either integral or non-integral, according to convenience of construction.

(c) The utilization of a check-valve, to prevent the return of air pressure from the brake-cylinder to the train-pipe, after the train-pipe air has entered that cylinder.

3d. There is no difference either of "principle" or "mode of operation" between the complainants' and defendants' quick-action triple valves.

590 Counsel for defendants objects to this last answer because:

First, it is really not evidence, but in large part, is a specious and labored argument of the witness.

Second, because the last question was addressed to the witness "as a mechanical engineer familiar with air-brake practice," while much of the answer assumes to expound and explain patent No.

360,070 itself; the answer therefore is the testimony of a patent expert, for which the witness has shown no qualification.

Third, the answer is objected to because the question called for the witness' understanding of the "principle" or "mode of operation" of the appliance of patent 360,070, and in what particular the defendants' valves differ therefrom, while the witness, pretending to answer this question only, has in fact volunteered a long argument, much of which is about matter not called for in the question.

In reply to the foregoing objection of defendants' counsel, counsel for complainants respectfully submits to the court, that, as defendants' record will show, the witness J. B. Church, a so-called "patent expert" is a mere theorist, having no practical mechanical training or experience whatever, and that in his answer 12, as to the correctness of which this witness was interrogated, he has, in support of his allegation that there is a difference "in principle or mode of operation" between the defendants' and complainants' devices, not only made a number of statements of alleged matters of fact, but has also offered an argument, which it is submitted is quite as fully open to the charge of being "specious and labored" as any statements made by this witness can possibly be. It is manifestly both

competent and proper to offer the testimony of a mechanical engineer familiar with air-brake practice, in refutation of, and reply to, the statements and arguments of defendants' so-called "patent expert," and equally proper that this witness, who speaks from a *practical* standpoint, shall give his reasons for the assertions he makes, as well as indicate to the court the misleading character of the pretended comparisons made by Mr. Church.

It is further submitted that this witness has not attempted "to expound and explain" anything, other than the construction and principle of operation of the device of patent 360,070, so far as he has referred to that patent, and it would certainly seem that a practical man, "a mechanical engineer familiar with air-brake practice," ought to be familiar with the "principle" or "mode of operation" of the appliance of patent 360,070, at least as fully as a mere theorist like Mr. Church, and that his expressions, with relation to such "principle" or "mode of operation," are fully within the scope of his qualifications, which it will be noted, do not include expounding the meaning and scope of patent claims, or the discussion of any other matters of law.

Counsel for defendants submits to the court that "a mechanical engineer familiar with air-brake practice," and who has shown no qualifications for explaining the scope of letters patent, should not assume to explain the scope of the specification of the patent in suit, simply because he refrains from testifying as to the scope of the claims of said patent.

To which counsel for complainants replies, that it would seem that the error of defendants' counsel, in making the objection that he has done, is due to the fact that he has failed to recognize that the specification and drawings of a patent constitute a technical description of an appliance, addressed to just such practical men as the witness, and that if he is not able to understand,

and explain fully, all points relating to the construction and principle of operation of the appliance recited in such technical description, he is not a competent mechanical engineer. Defendants' counsel seems to confound the qualifications of the witness for dealing with this technical description, with other qualifications which he does not profess to have, namely, those of passing upon and discussing the scope and meaning of the claims of the patent, which are matters of law, with which the witness very properly and sensibly does not propose to meddle.

Counsel for defendants has objected to the testimony of the witness, for the purpose of calling the attention of the court to the fact, that, while the witness is avowedly refraining from expounding the claims of the patent, he is really endeavoring to make it appear that he gathers, from the specification of the patent, an interpretation and meaning not warranted. The court will discern in this the evident bias and unfairness of the witness.

673 Q. How far, if at all, do you find Mr. Boyden's statements on page 27 (D. R.) as to an alleged "fourth valve," and its supposed function, to be true and correct statements?

A. They are entirely incorrect, for the following reasons:

(a) Mr. Boyden has said that the valve port 35 is a main valve, which it is not, as it is not the valve "mainly" used in braking, and is only used in the performance of the emergency, quick action, or fourth function, of quick-action triple valves. The "main" valve is the valve 14, which performs, in triple valves, the "main" function of braking.

Adjourned to Friday, January 5, 1894, at 11 a. m.

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NEW YORK, *January 5, 1894*—11 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of D. L. BARNES resumed:

A. to Q. 673 continued.

(b) Mr. Boyden has referred to "cut No. 5," complainants' device. Any reference to this cut is necessarily incomplete and incorrect, because it indicates that the complainants' device has a function which it doesn't have at all, namely, what Mr. Boyden has denominated "this function," "the above function," "fourth valve," "main valve, whose function." The impression is conveyed that this is a separate function, and that all of the function is described, whereas it is distinctly in error in the following points:

1st. The auxiliary valve 41 is open, and there is every condition present necessary for the admission of air from the train-pipe to the brake-cylinder through passage 43, but no such action is indicated on the cut. In point of fact, the positions of the parts are identical with those of drawing No. 7, and, therefore, the same function would be performed in the same way. For all the purposes of describing the quick-action function and the office of port 35, which

Mr. Boyden has denominated the "fourth valve," drawing No. 7 is competent, while drawing No. 5 is not.

2nd. Port 35, which Mr. Boyden has denominated the "fourth valve," cannot be brought into the position shown in cut 5, without the performance of the true fourth function of quick action triple valve, namely, quick action, and in the manner that is shown in drawing No. 7.

(c) The only function of port 35, its office and purpose, is the second function of triple valves prior to 1887, namely, that of admitting air from the auxiliary reservoir to the brake-cylinder.

594 It has no other function, and can have no other, as is manifest from its construction, and its location in relation to other parts.

(d) To show the function of port 35 to be the second function of triple valves prior to 1887, I will illustrate how port 35 can be entirely removed, and its function performed in the same way, to produce the same useful and practical results, by another port of triple valves prior to 1887, which has the same function. The addition of port 35 is a matter only of preference in construction, not of necessity.

I will now refer to "Complainants' Exhibit Westinghouse Modification:"

In this construction, port 35 has been absolutely removed, and no equivalent in structure has been substituted. The identical equivalent in function, is, in this arrangement, formed by an extension of the port opening of the port 31, which is manifestly the part which performs the second function of triple valves prior to 1887, and in this extension, marked *x*, and by it, no new function is performed, but only the same function of passage 31, namely, that of admitting air from the auxiliary reservoir to the brake-cylinder.

"Complainants' Exhibit Westinghouse Modification" is a perfectly practical construction, and will perform all the functions, namely, the three of triple valves prior to 1887, and the fourth, or quick-action, function of quick-action triple valves, and produce just as perfect practical results as "complainants' valve."

(e) Mr. Boyden has said, that when defendants' quick-action triple valves are performing the "above function," (which is, in fact, the second function of triple valves prior to 1887, for the obvious reason that he does not say that the quick-action function is being performed at the same time), "the air passes from the auxiliary reservoir through the ports A and B into the chamber C, then passes through the port uncovered by the valve 22 to the brake-cylinder, through the passage H," and refers to "cut No. 6." It is

595 obvious, from the construction of defendants' valve, and from the practical experiments which I have performed with defendants' valves, both at Wilmerding, and at Baltimore in the presence of Mr. Boyden, that defendants' valves cannot be operated in this way. To these experiments I will refer later in this answer.

Drawing No. 6 is in error, in that the check-valve 26, provided for the purpose of preventing the return of air from the brake-

cylinder to the train-pipe, is not shown opened when the piston has traveled to the limit of its stroke, it is as shown in drawing No. 6. Neither is it indicated that air is passing, or has passed, from the train-pipe to the brake-cylinder, as is manifest must be the case when the piston is in the position shown in drawing No. 6.

Drawing No. 8 shows the fact of operation, and, for all purposes of description of the function, of passage B, valve 22, check-valve 26, and the farther traverse of the piston, drawing No. 8 is competent and complete, while drawing No. 6 is wrong and incomplete.

(f) Valve 22 cannot be lifted from its seat to perform any useful function of braking, without the performance of the fourth or quick-action function, and without causing the check-valve 26 to assume the position shown in drawing No. 8.

(g) Drawings Nos. 5 and 6 are misleading and incorrect.

(h) I have shown, in a preceding answer, the equivalence of valve 14 of complainant's device, and valve 18, *i, k, j, 17, 40*, as it has been variously marked, of defendants' device, and that these valves perform the same functions, which are the "main" functions of braking, and, therefore, if there are any valves in these devices that are competent to be termed "main" valves, they are those that I have just referred to. As I have before explained, in a preceding answer, it is indefinite and unsafe to describe parts of compound valves, in any way except by referring to their functions. For this reason, and others that I have given, it is indefinite and non-descriptive to use the term- "fourth valve" and "main valve."

In conclusion, and for the reasons that I have set forth in detail, I find Mr. Boyden's statements on page 27 (D. R.) as to an alleged "fourth valve," and its supposed function, to be untrue and incorrect.

The experiments that I have referred to were made at Wilmerding by me November 6, 1893, and by Mr. Boyden, and witnessed by me, at Baltimore November 7, 1893. These experiments were as follows:

(a) Defendants' 1891 valve was operated as a quick-action triple valve, and it performed all the functions, namely, the four I have described, of complainants' valve, producing exactly the same results. The results were identical, in the same way as described in defendants' 1891 catalogue, page 29, which I now quote:

"The actions of this valve in graduating, full-service application, quick action and the release, are the same as the new Westinghouse quick-action valve, thereby producing the same results in braking, which renders the cars equipped with the two valves perfectly interchangeable—the hose couplings being the same."

The same results were exhibited by Mr. Boyden at Baltimore, and were witnessed by me.

(b) I attempted, by a rapid reduction of train-pipe pressure under the most favorable conditions, namely, with a short train-pipe, and with one valve, and with both a plain engineer's one-way valve and with an automatic engineer's valve, to pull the valve 22 off of its seat and admit auxiliary reservoir pressure through the port un-

covered by valve 22, for the purpose of applying the single brake, and to apply that brake more quickly, but without quick action.

This I could not do.

597 In Mr. Boyden's experiment at Baltimore, witnessed by me, I observed that the same results were obtained.

One point of importance here, and which further convinces me that valve 22 has no other office, in practical braking, than for the purpose of performing the fourth or quick-action function, is that defendants' 1891 catalogue, page 29, from which I have quoted in the foregoing, states that:

"The actions of this valve in graduating, full-service application, quick action and the release, are the same as the new Westinghouse quick-action valve, thereby producing the same results in braking."

When the brakes are applied with auxiliary reservoir pressure, if a large port, such as that opened by valve 22, should be opened between the auxiliary reservoir and the brake-cylinder, the results in braking would be disastrous and would cause severe and damaging shocks in a train. The complainants' device does not give any such results, which would follow from the opening of a large port, and neither does defendants' valve give any such result, as is set forth in the paragraph from defendants' 1891 catalogue, to which I have made reference, and, therefore, it is clear that, in practical braking, no large passage between the auxiliary reservoir and the brake-cylinder, like that uncovered by valve 22, is opened in the practical operation of defendants' valves.

(c) To further show the real office of valve 22, and to satisfy myself whether it was essential, or used practically to admit air from the auxiliary reservoir to the brake-cylinder for service application, I had valve 22 fixed to its seat, so that it could not be lifted. Now it is noticeable that the passage uncovered by valve 22, is vastly larger than passage B, through which all air must come from the auxiliary reservoir to reach the brake-cylinder, through the passage uncovered by valve 22; hence, so far as the relative
598 dimensions of valve 22, and the passage which it uncovers, are concerned, such large dimensions were provided for some other purpose than the admission of air to the brake-cylinder from the auxiliary reservoir. To determine whether a simple enlargement of the openings through the valve 18, which is manifestly a simpler and more practical construction than that of valve 22, which has a large flat seat liable to give trouble in practical operation, would transmit all the air from the auxiliary reservoir that could come through passage B, and thus permit the application of the brakes as quickly, by auxiliary reservoir pressure, as it could be applied through passage B, I had the holes through stem 18 enlarged, so that the combined area was greater than the area of passage B, and therefore, more air could be passed through the holes in stem 18 than through passage B. The result showed that, with this modification, namely, with valve 22 fixed to its seat, defendants' valves would graduate and apply the brakes as fully as they could be applied by auxiliary reservoir pressure through the passage B,

and this showed to me that the simpler construction of enlarging the holes through the stem 18 would perform all that the defendants have claimed to be performed by valve 22 in applying the brakes with auxiliary reservoir pressure, and from that I am led to believe that the valve 22, with its attendant mechanical difficulties in practical operation, and the increased number of parts and chances for leakage, and defects from sand and grit getting under its seat, was devised, not for the purpose of a quick-service application, as claimed, but because its presence is compelled in order to get a performance of the fourth, auxiliary, or quick-action function, namely, to admit air from the train-pipe to the brake-cylinder.

An experiment of this kind was not exhibited by Mr. Boyden at Baltimore.

(d) To determine the effect of a removal of a restricted passage between the auxiliary reservoir and the brake-cylinder, such
599 as passage B of defendants' valve, and passage 35 of complainants' valve, I had the ring 9 removed from defendants' valve, and found that, with this modification, quick action could not be obtained, *because the auxiliary reservoir pressure entering the chamber C, prevented the opening of check-valve 26 by the lower train-pipe pressure, when valve 22 was pulled off of its seat by the piston, (thus making the chamber C practically a part of the brake-cylinder cavity,) just the same as would be the case with complainants' device, if passage 35 was made a large and non-restricted passage, thus admitting a large volume of auxiliary reservoir air quickly to the brake-cylinder, which would prevent the opening of check-valve 49 by the lower train-pipe pressure when valve 41 was opened, (the chamber in which valve 49 is located being practically a part of the brake-cylinder cavity).*

In both these devices the pressure from the auxiliary reservoir, going quickly into the brake-cylinders, and reaching check-valve 49, would prevent their opening by the lower train-pipe pressure.

From the fact that the result of the suffocation of the two check-valves is the same, and is produced in the same way, namely, by the suppression of the restricted passages B and 35, I was led to the conviction that these restricted passages are equivalent and have the same office.

Test of this kind was performed by Mr. Boyden subsequently at Baltimore, and witnessed by me, and with the same result, and by these last tests I was not led to change my first conviction.

(e) In another experiment I had the hole in the stem 18 of defendants' valve plugged, so as to be inoperative. In this modification, valve 22 could be lifted from its seat, and by using great care with the short train-pipe, which is a favorable condition, I could make two applications from the auxiliary reservoir to the brake-cylinder, the first being an application of about 25 pounds in the brake-cylinder, the second being full application. Generally, however, whenever the valve 22 was lifted from its seat the brakes
600 were fully applied with auxiliary pressure. But, in order to perform this experiment, the restricted passage B had to be removed, which was done by removing the ring 9, otherwise, in every instance, without a single exception, quick action took place at once and fully whenever valve 22 was lifted from its seat. This

showed to me that whenever valve 22 was used for the admission of auxiliary pressure reservoir to the brake-cylinder in combination with the restricted passage B, quick action invariably took place at once and completely. It is important to note, that at this time, all uncertainties as to how the auxiliary reservoir pressure was admitted to the brake-cylinder, were removed by the plugging of the holes through the stem 18; this compelled the auxiliary reservoir pressure to pass through the valve 22, and gave conditions that were free from any bias and uncertainty.

In this experiment, if the capability, or the function, of valve 22, was to have enabled a quick application of the brakes with auxiliary reservoir pressure, without getting quick action, as claimed by the defendants, such result would have been accomplished as the conditions were most favorable, but such result was not accomplished, and by no special or "trick" manipulation, could I produce, by opening valve 22, the performance of anything but quick action.

The conditions were favorable to show the capability of valve 22, to perform what Mr. Boyden has termed, the function of the "fourth valve, main valve," for the following reasons:

1st. The plugging of the holes in the stem 18 prevented the admission of auxiliary reservoir pressure to the brake-cylinder, by way of those holes, and confined the admission of auxiliary reservoir pressure to the valve 22, thus giving that valve a full opportunity to exhibit its capability of admitting auxiliary reservoir pressure without giving quick action.

2d. The conditions were favorable, because the plugging of the holes in stem 18 permitted a quicker formation of a momentary differential pressure on the opposite sides of the piston 29, because the air from the auxiliary reservoir, flowing into the back side of the piston, would not be reduced in pressure by being drawn through passage B and cavity C to the brake-cylinder, through the holes in the stem 18, as these holes were plugged.

3d. Only one brake-valve was used and the piping necessary for one car. This permitted a quick discharge of air from the train-pipe, and thus gave a more rapid formation of differential pressures on the opposite sides of the piston 29.

To further satisfy myself that the use of a short pipe and a single valve was more favorable to the operation of defendants' valve as claimed, by the admission of auxiliary reservoir pressure to the brake-cylinder through valve 22, without the performance of quick action, I performed an experiment with a triple valve having the three functions of triple valves prior to 1887, namely, a valve of the type shown in patent No. 220,556, granted to George Westinghouse, Jr., October 14, 1879, which was modified by increasing the performance of the second function of triple valves prior to 1887, namely, the admission of auxiliary reservoir pressure to the brake-cylinder by providing a larger opening of the passage C to the brake-cylinder. This gave a more forcible or quicker application of the auxiliary reservoir pressure to the brake-cylinder; when the port C was opened wider, and with one brake, there was a slight difference in the time of application, say about a quarter of a second, but,

with twenty-five brakes, I could not produce a larger opening of the passage C, and thereby get a greater degree of performance of the second function, on more than the first few brakes. This showed me three things:

1st. That a single brake and short piping was more favorable for the performance, in a higher degree, of the second function of a triple valve prior to 1887, and therefore showed that if valve 22 of defendants' valve could perform the second function of triple
602 valves prior to 1887, at all, it would be performed under the conditions I had adopted for the experiment before cited in this answer, and under which condition it did not perform it as claimed by defendants.

2d. The experiment showed that there was no practical value in providing for a higher degree of performance of the second function on trains of practical length.

3d. The experiment showed that the front brakes of a practical train would apply quicker than the succeeding brakes in the train, and cause serious shocks and frighten passengers unnecessarily, throw down live stock, and cause a shifting of the freight in the cars, besides damaging the cars, all of which has been fully established by practical experiments with actual trains on railroads, more especially the experiments performed in 1886 and 1887, by a committee appointed by the Master Car Builders' Association, at Burlington, Iowa.

(f) At Baltimore Mr. Boyden showed an experiment which I witnessed, with a device similar to that shown in drawing No. 10 (D. R.)

The operation of this device, with all of the details present, as shown in the drawing, which make it a quick-action triple valve, having the four functions of practical operation, was identical with that of the complainants' device, with defendants' valves, and with the description of the operation of defendants' valve as given on page 29 of defendants' 1891 catalogue.

With the ring 9 removed, which destroys the restricted passage B, corresponding to the restricted passage 35 of complainants' device, quick action did not take place, because the admission of auxiliary reservoir pressure to the brake-cylinder was so rapid as to prevent the opening of check-valve 26 by the lower train-pipe pressure, in the manner which I have previously described.

With the ring 9 removed, and the restricted passage B destroyed, this valve, drawing No. 10, operated precisely as defendants'
603 valve with ring 9 removed, and without any difference. It is not necessary, therefore, for me to detail the action of this valve, but I will refer, for a general description of its action, to the preceding part of this answer where I have described the action of defendants' valve with ring 9 removed.

This valve, drawing No. 10, is an example of integral construction of the auxiliary valve, and I will now describe its correspondence, in essential features and characteristics, with complainants' and defendants' valves.

The restricted passage B is idle, when the valve is performing

the three triple-valve functions, and is operated to restrict the flow of auxiliary reservoir pressure in the performance of the auxiliary or quick-action function, and therefore corresponds exactly, in function, with restricted passage B of defendants' valve and restricted passage 35 of complainants' valve.

Check-valve 26, of drawing No. 10, is for the purpose of preventing the return of train-pipe air to the train-pipe, after it has once passed into the brake-cylinder, for the performance of the auxiliary function. The fact that the air, in feeding and charging, passes from the main air pipe through check-valve 26, both in the device shown in drawing No. 10 and in defendants' valves, and does not do so in complainants' valve through check-valve 49, is immaterial for two reasons:

1st. The purpose of the check-valves, as shown by their location and size relative to the other parts, is to assist in the performance of the auxiliary or fourth function, by preventing the return of air pressure from the brake-cylinder to the train-pipe, as I have described.

2d. In none of these valves, as practically made, is the feed controlled by the check-valve, but is, instead, controlled by infinitely smaller fine grooves, properly located between the train-pipe and the auxiliary reservoir.

Hence, the function of check-valve 26 of drawing No. 10, 604 is the same as the function of check-valve 26 of defendants' valve, and check-valve 49 of complainants' valve.

The passage C, which it will be noticed is enormously larger than the passage s¹ of drawing No. 10, is for the purpose of admitting, in large quantity, the train-pipe pressure to the brake-cylinder, in the performance of the auxiliary or fourth function, and is located to correspond with an integral auxiliary-valve construction that I have described in a preceding answer. The passage C, therefore, corresponds in function with the passage 42 of complainants' valve, and the passage uncovered by valve 22 of defendants' valve.

The valve H, of drawing No. 10, is the type of integral auxiliary valve which I have described in a preceding answer, whose auxiliary function is the opening of a large passage to the brake-cylinder, for the admission of train-pipe pressure, and therefore corresponds with the auxiliary valve 41 of complainants' valve, and the auxiliary valve 22 of defendants' valve.

The further traverse of the piston provided in the device of drawing No. 10, has its sole purpose in opening the auxiliary passage and valve just described, and therefore corresponds to the further traverse of the piston of complainants' valve and defendants' valve, all of which further traverses actuate auxiliary valves, for the performance of the auxiliary or fourth function of quick-action triple valves.

In order that I may not be misunderstood, or at fault, by failing to describe everything which I observed in the experiments performed by me at Wilmerding, and by Mr. Boyden at Baltimore, I will now describe in detail one result obtained, which is immaterial, so far as it bears on the question in point, namely, the capability

of valve 22 of defendants' valve, for the admission of auxiliary reservoir pressure to the brake-cylinder, without, at the same time, getting quick action. But before doing this, it will be necessary to

explain more in detail than has been done before, so far as

605 I can learn from the reading of the testimony in this case,

the construction and operation of the device used by Mr. Boyden to determine when quick action takes place, namely, "Illustration of the glass cylinder and wood ball referred to in Mr. Boyden's answer to Q. 14" which I shall hereafter refer to as the 'ball device.'

The ball has its normal position, as shown in the illustration, and can be observed through the glass case. When the air moves from the main air pipe through the glass cylinder, in sufficient quantity, it rolls the wood ball up the inclined surface of the glass cylinder, until it reaches the opposite end, where it practically stops the main passage to the brake-cylinder, and the air from the main air pipe flows through the holes provided laterally. It is clear then that these lateral holes must have a large area in total, namely, sufficient to transmit the air from the train-pipe to the brake-cylinder, during quick action. That these holes are of large size was sufficiently shown by the experiments, in which, as I have said, quick action took place perfectly, and the large volume of air required for quick action must have passed through these holes. These lateral holes are practically of the same dimensions on both ends.

It is evident then, that there is a large and substantial passage from the main air pipe to the brake-cylinder, through the lateral holes, and around the wood ball in the glass cylinder, when the large central hole is plugged by the wood ball, as shown in the illustration.

This device then is not adapted to indicate when there is a flow of small amounts of air from the train-pipe to the brake-cylinder, but is adapted to show a flow of air when the flow is very great. The device does indicate a marked flow of air, when there is a quick action, in the sense in which I have described the term in a preceding answer, but it will not indicate, I think, a *small* flow of air from the main air pipe to the brake-cylinder which probably takes place

under the conditions of the experiment I am about to recite

606 for the reason that there is a large open passage through the glass cylinder that is not plugged by the wood ball. I am aware that I am dealing with very fine points, but such close discriminations are warranted from the fact that the experiment I am about to recite, is one that deals with minute discriminations, so minute, in fact, that I was unable to tell whether air passed from the train-pipe to the brake-cylinder through valve 22, or not.

It will be necessary, also, to say that the gauges on the brake cylinder and the auxiliary reservoir, in the apparatus used by Mr. Boyden for experimental exhibit, were not accurate, and did not coincide, and were so acknowledged by Mr. Boyden. Mr. Boyden offered to change these gauges, or correct them, but I did not deem it necessary, as I did not think the small discriminations and differ

ences incident to that experiment were material. The experiment is as follows:

One of defendants' valves, of the type shown in defendants' 1891 catalogue, was shown to be operated as a quick-action triple valve having the essential four functions. Following that, there were repeated attempts to manipulate the engineers' valve so as to admit auxiliary reservoir pressure to the brake-cylinder, through valve 22, without opening check-valve 26 and admitting air from the train-pipe to the brake-cylinder. The conditions were favorable, because there was but one brake and comparatively short piping. In about half of the experiments, full quick action took place, and air passed from the train-pipe to the brake-cylinder in sufficiently large volume to move the wooden ball. In the other half of the experiments, the following took place:

Air from the auxiliary reservoir passed through the holes in stem 18 until the pressure in the brake-cylinder was from 90 to 95 per cent. complete and full, for service application. The pressure in the brake-cylinder at that time acting under valve 22, together with the differential pressure on the opposite sides of piston 29, acted to lift valve 22 from its seat, and, at that instant, the finger of the pressure gauge on the brake-cylinder flew suddenly around a short distance, say about three pounds, to its highest indication. The amount of air admitted at this time was certainly very small, not enough to make any practical difference in braking, or to lift check-valve 26 enough, so that it could be observed, even if all the air admitted at that time had been admitted from the train-pipe. I could not determine whether check-valve 26 lifted or not, or whether any air passed from the train-pipe to the brake-cylinder, as the apparatus for showing this was not delicate enough to measure or indicate the passage of such small amounts of air.

To sum up my answer to this question, I will say that Mr. Boyden's statement, as to an alleged "fourth valve" and "fourth function" of triple valves prior to 1887 and of complainants' and defendants' valves, is neither true or correct, as I have determined from an examination of the devices and from experiments, as set forth in this answer.

Counsel for defendants objects to all that part of the previous answer included under the "reasons" designated—*a, b, c, d, e, f, g, and h*, because that part of the answer contains a plain misrepresentation of Mr. Boyden's statements on page 27 (D. R.) as to complainants' "fourth valve," and as to Mr. Boyden's true reason for using illustrative "cut No. 5" in connection with his said statements.

This will be evident to the court by reference to defendants' record, page 125, and Mr. Boyden's answers 177 178 on that page. Mr. Boyden, in said answer 177, distinctly explains the object of the illustrative "cut No. 5" as follows, A. 177:

"No, I am not, as I used cut No. 5 *only* to show the course of the auxiliary reservoir air to the brake-cylinder when passing through the port 35, in my answer to Q. 9."

Counsel for complainants objects to the lumbering of the record with statements, in the nature of testimony, on the

part of defendants' counsel, and arguments in support of such statements, and suggests that whatever argumentative matter defendants' counsel desires to present can be submitted much more properly, and certainly quite as effectively, at the hearing of this cause.

674 Q. To what extent are such statements of your last preceding answer as relate to the appliance of patent 360,070, applicable to the statements of defendants' witness, Church, in folios 680, 681, pages 170, 171 (D. R.)?

A. They are fully applicable to the statements of Mr. Church.

Adjourned to Saturday, January 6, 1894, at 11 a. m.

NEW YORK, *January 6, 1894*—11 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of D. L. BARNES resumed:

675 Q. In folios 110, 111, p. 28 (D. R.), Mr. Boyden recites "four valves" as forming the "triple valve"—that is, the triple valve proper, in patent 360,070 and in defendants' quick-action triple valves. To what extent is such a recital a true and correct one?

A. Mr. Boyden's recital is untrue and incorrect for the following reasons, and for further reasons which I have given in preceding answers.

(a) Triple valves prior to 1887 and the plain triple-valve functions of patent 360,070 are but *three*, namely, the first, second and third that I have described in a preceding answer.

609 (b) The "main valve" which Mr. Boyden has wrongly said is port 35, is in fact the valve which performs the main functions of braking, namely, the three functions of triple valves used prior to 1887.

(c) The port 35 has only one function, that of admitting the air from the auxiliary reservoir to the brake-cylinder, which is the second function of triple valves used prior to 1887.

(d) The equivalence of port 35, in function and result, with port 31, which is the port which performs the second function of the quick-action triple valves, I have shown in my answer to Q. 673, when referring to "Complainants' Exhibit Westinghouse Modification," in which the port 35 has been entirely removed, and "the identical equivalent, in function is, in this arrangement, formed by an extension of the port opening of the port 31, which is manifestly the part which performs the second function of triple valves prior to 1887, and, in this extension, marked *x*, and by it, no new function is performed, but only the same function of passage 31, namely, that of admitting air from the auxiliary reservoir to the brake-cylinder."

(e) This reply of Mr. Boyden is another instance of the indefiniteness and inaccuracy of comparing compound structures, on the basis of parts to which more or less empirical names are given, instead of comparing them by their functions. As I have said before,

the number of the parts, or the names of the parts, do not necessarily indicate their equivalence in functions.

(f) The error in the parallel-column comparison given in Mr. Boyden's answer, is apparent from the fact, which I have shown in answer to Q. 673, that the valve 22 of defendants' valve has no office in the performance of any of the three triple-valve functions of triple valves prior to 1887.

(g) If valve 22 of defendants' valve is to be denominated as the "main valve," as has been done by Mr. Boyden, then valve 41 of complainants' valve should also be denominated a "main valve," as they both have the same function, namely, the fourth or auxiliary function of quick-action triple valves. Manifestly, it is not descriptive, but is, instead, misleading, to denominate either valve 22 of defendants' valve, or 41 of complainants' valve, as a "main valve" for the reason that those valves are not *mainly* used, but are used only for unusual conditions and for emergency. In fact such valves have been frequently referred to in the art as being "emergency" valves.

(h) A true comparison of the parts forming the three triple-valve functions prior to 1887 and those having the fourth or auxiliary function of quick-action triple valves, in complainants' and defendants' devices, is as follows:

- 1st. Feeding-in valve :
Valve 51, complainants' valve.
Small grooves in piston stem, defendants' valves.
- 2d. Valve for admission of auxiliary reservoir air to the brake-cylinder :
Valves 14 and 29 and ports, complainants' valve.
Valve 18 (13) and ports, defendants' valves.
- 3d. Exhaust valve :
Valves 14, 33 and port, complainants' valve.
Valve 17 and port, defendants' valves.
- 4th. Auxiliary valve for the performance of the auxiliary or quick-action function :
Valve 41 and port, complainants' valve.
Valve 22 (15) defendants' valves.

As these valves all have corresponding functions, the comparison I have made is a manifestly correct one.

611 676 Q. What, if any, plain triple valve, or triple-valve proper, functions, are, in practice, performed, or are, in practice, required to be performed, in the device of patent 360,070, or in the defendants' quick-action triple-valve devices, by any valve or valve element, other than the first, second and third enumerated by Mr. Boyden in folios 110, p. 28 (D. R.)?

A. None whatsoever, as I have set forth in the last preceding answer.

677 Q. Is, or is not, the statement of Mr. Boyden, in the first paragraph of folio 116, p. 29 (D. R.), that one of the four valves forming the triple valve proper, in the defendants' structure, admits the main air-pipe air to the brake-cylinder, simultaneously with the

auxiliary reservoir air, when producing quick action, a true and correct statement?

A. It is quite untrue and incorrect for the following reasons:

(a) In defendants' valves, the valve which performs the second function of a "triple valve proper," namely, the admission of auxiliary reservoir pressure to the brake-cylinder, is valve 18, which valve is not of any value during the performance of the fourth or auxiliary function of quick-action triple valves, as I have shown by the recital of experiments made by me in a preceding answer, in which the holes of valve 18 used for the second function were suppressed by being plugged up. In that modified construction, quick action took place correctly. I have shown that valve 22 is not used in the performance of any of the functions of "a triple valve proper."

(b) During the performance of the quick-action function, the flow of auxiliary reservoir pressure to the brake-cylinder is through valve 22, but is controlled, in amount, by the restricted passage B, which is the equivalent of port 35 of complainants' device.

(c) What Mr. Boyden has termed the "fifth or auxiliary valve," but which is, in fact, simply an auxiliary valve, as I do not consider the numbering of valves of compound structures competent, is found in defendants' quick-action triple valves, in the form of valve 22, which is used solely for, and has a capacity and location suitable for the admission of "main air-pipe air to the brake-cylinder."

For these reasons, it is clear that the auxiliary valve, for the performance of the auxiliary function, or what Mr. Boyden has incorrectly termed the "fifth" valve, is present in defendants' devices, and no valve that is used in the performance of the functions of "the triple valve proper," is used, in defendants' devices, for performing the auxiliary or quick-action function.

678 Q. Mr. Boyden states on page 30 (D. R.) that—

"This distinctly shows that the complainants' device uses two valves to perform the quick application of the brakes, one of which belongs to the *triple valve proper* while the other is an *auxiliary valve additional* to the triple-valve structure."

I understand from your preceding testimony that you have disagreed with other statements of the defendants' witnesses which appear to me to be to the same effect as that quoted, but wish you would state whether or not you find this specific statement to be a true and correct one.

A. This statement is clearly untrue and incorrect, for the reasons that I have set forth in a preceding answer, and for the further reason that the term "additional," I do not find to be warranted by any description in the specification of the patent 360,070. This statement by Mr. Boyden is still another illustration of the inaccuracy of descriptions and comparisons of compound valves, based on empirical names of parts, instead of, as they should be, on functions.

679 Q. On pages 20 and 21 (D. R.) Mr. Boyden makes the follow-

ing statement, as to the operation of defendants' quick-action triple-valve plate XI, defendants' 1891 catalogue, to wit:

613 "To apply the brakes fully with the auxiliary reservoir pressure by the final movement of the piston, sufficient pressure is gradually exhausted from the main air pipe to move the piston its full stroke. This will unseat the main valve 22, and thereby establish full communication between the auxiliary reservoir and brake-cylinder and apply the brakes with the full auxiliary reservoir pressure.

"The operations just described are those of the 'triple valve,' *per se*, and are such as are used in the art prior to 1887."

Mr. Church makes a statement, which I understand to be substantially to the same effect, as to defendants' 1889 device, in the paragraph on page 196 (D. R.) commencing "To apply the brakes with full power in the shortest possible time," &c., and continuing in the first paragraph of folio 783, on same page, that "the operations described are generally the same as those performed by the 'triple valve proper' and do not include the special function of a quick-action triple valve."

To what extent, if at all, are the above-quoted statements of defendants' witnesses true and correct statements of fact?

A. These statements are entirely untrue and incorrect for the following reasons:

(a) Valve 22 cannot be unseated or operated to perform any of the functions of the "triple valve *per se*," as I have explained in a preceding answer, and no valve having the function of the auxiliary valve 22 was used in triple valves prior to 1887.

(b) The function, which is an auxiliary one, of valve 22, is that of opening a passage between the train-pipe and the brake-cylinder, to admit train-pipe pressure to the brake-cylinder, upon the further traverse of the piston, and valve 22 can be operated, practically, in no other way.

(c) Mr. Church practically denies that valve 22 is used to admit train-pipe pressure to the brake-cylinder, and yet, it is evident from the construction, that valve 22 is the *only* valve that 614 can be used in defendants' devices for that purpose. Mr. Church's practical denial is made in the following words:

"The operations described (Mr. Church is now referring to the opening of valve 22 (15) by the further traverse of the triple-valve piston) do not include the special functions of a quick-action triple valve, as that term is used to indicate the depletion of the train-pipe and the delivery of the air from the train-pipe into the brake-cylinder."

Clearly, valve 22 cannot be opened, in practical operation, without doing just what Mr. Church has said it cannot do.

680 Q. In his answer to X Q. 152, Mr. Boyden admitted that it is the fact that the functions, and the *only* functions, of the valve mechanism of patent 360,070, as recited in the specification of said patent, between line 80, p. 3, and line 51, p. 4, are:

1st. To admit air from the main air pipe to the auxiliary reservoir.

2d. To admit air from the auxiliary reservoir to the brake-cylinder, through the port controlled by the graduating valve 29.

3d. To exhaust air from the brake-cylinder to the atmosphere.

4th. To effect the admission of air directly from the main air pipe to the brake-cylinder, accompanied by a subsequent admission of auxiliary reservoir air through the port 35.

Please state whether or not you agree with Mr. Boyden, and state also whether or not the quick-action triple valve of patent 360,070 performs in practice, any function whatever, other than the four above specified?

A. I agree exactly with Mr. Boyden, as the four functions are those that I have described as being the sole and only functions of quick-action triple valves, and such valves have no other function in practical operation. I also find that Mr. Boyden has described quick-action triple valves as having the same four
615 and only functions, on page 23 (D. R.) folios 90 and 91.

681 Q. How many, and which, of the functions recited in the last preceding question were performed by triple valves, such as were known in the art prior to 1887?

A. Three, the first, second and third.

682 Q. From your familiarity with the art in air brakes for railroads, please state when first, and by whom, a triple-valve device was produced, having the capacity of performing the first, second and third functions recited in question 680, and having, in addition thereto, the capacity of effecting, when desired, the application of the brakes by the admission of air directly from the main air pipe to the brake-cylinder.

A. Such a triple-valve device was, to the best of my knowledge, first produced by George Westinghouse, Jr., and is described and shown in his patent No. 360,070.

683 Q. From your practical knowledge of, and experience with, quick-action automatic brakes, please state what are the functions, and the *only* functions, performed in practice by the defendants' quick-action triple valves shown in plate IX defendants' 1889 catalogue and plate XI defendants' 1891 catalogue.

A. The entire and only functions of these constructions are those that I have designated as the first, second, third and fourth functions of quick-action triple valves. These are as follows:

1st. The admission of air from the train-pipe to the auxiliary reservoir through the feeding-in port.

2nd. The admission of air from the auxiliary reservoir to the brake-cylinder, for the purpose of applying the brakes with auxiliary reservoir pressure, such as was common in the art prior to 1887. This is accomplished by means of the ports in valve 18, defendants' 1891 valve, and by valve 13, defendants' 1889 valve.

3rd. The exhausting of the air from the brake-cylinder to the atmosphere. This is accomplished by valve 17.

616 4th. The application of the brakes by train-pipe pressure, for the performance of the auxiliary or quick-action function. This is accomplished by the valve 22 (15) upon the further traverse of the piston.

684 Q. How many, and which, of these functions are, operatively and in results, in correspondence with the functions performed by triple valves such as were known in the art prior to 1887?

A. The first, second and third only.

685 Q. What is the function, and the *only* function, in practical operation, of the valve 22 of defendants' quick-action triple valves, plate XI defendants' 1891 catalogue, and the corresponding valve 15 of plate IX defendants' 1889 catalogue; and by what mechanical means or member are said valves actuated?

A. The function, and the only function, of valve 22 (15) of defendants' valves is to perform the auxiliary or fourth function, namely, quick action.

These valves 22 (15) are actuated solely by the piston of the triple valve upon its further traverse, which is a traverse over and above that necessary for the performance of the functions of a plain triple valve as known prior to 1887.

686 Q. In what, if any, particular, of function, means of actuation, or operative relation to the other members of the appliance which perform the first, second and third functions recited in your answer 683, does the valve 22 of defendants' 1891 quick-action triple valve, or the corresponding valve 15 of defendants' 1889 quick-action triple valve, differ from the valve 41 of the structure of patent 360,070?

A. It does not differ in any of the particulars recited.

687 Q. To what extent, if at all, is the valve 22 (15) of defendants' devices, a necessary, or a practically useful, member of said devices, for any purpose or function whatever, other than that of admitting air directly from the main air pipe to the brake-cylinder?

A. Valve 22 (15), of defendants' devices, is not at all necessary, or practically useful, for any other purpose or function whatever than that of admitting air directly from the main air pipe to the brake-cylinder for the performance of the auxiliary function.

This non-utility of valve 22 (15) during the performance of the first three functions of triple valves prior to 1887, I find to have been admitted by Mr. Boyden in answers to X Q. 230 and X Q. 232.

The full office of valve 22 (15) of defendants' devices is the performance of quick action.

688 Q. To what extent, if at all, is a construction such as is shown in patent 220,556, in which the port or passage leading from the auxiliary reservoir to the brake-cylinder may be controlled, so as to be either partially or fully opened or uncovered, essential or desirable in the operation of a triple valve proper as known prior to 1887?

A. It is neither essential nor desirable, and, furthermore, such construction would lead to very unsatisfactory, and, in some cases, damaging, results in practice. I have shown, in a preceding answer, wherein I described experiments with a valve of this kind, that the port leading to the brake-cylinder from the auxiliary reservoir could not be opened fully except on a few of the front cars of a train.

This result would cause the front brakes to apply at once, while the rear brakes would apply later, and cause damaging shocks in the train, for reasons which I have previously set forth.

One of the most difficult results to accomplish in designing plain or quick-action triple valves, is to obtain a uniform application throughout the train as nearly as possible. This fact alone shows the undesirability of the construction described in this question.

689 Q. As a matter of fact, do, or do not, the defendants' structures possess the capacity of producing the same effect in a service application of the brakes, as is produced if the piston and valve II of patent 220,556 are allowed to make the extreme traverse which the patent shows they are capable of making?

618 A. They do not, for, as I have shown by citation of experiments, it is impossible to apply the brakes with auxiliary reservoir pressure, in a service application, in any other way than through the small ports in valve 18, defendants' valve.

I have shown, by citation of experiments, the impracticability of lifting valve 22 (15) for a service application of the brakes without, in every instance, getting, at the same time, a quick-action application.

In the device of patent 220,556, if the piston and valve II make a complete traverse, as they may be made to do on a few cars, the brakes go on forcibly, as the air from the auxiliary reservoir passes through the full port C, but, in defendants' valves, the service application of the brakes can only be made moderately, just as in the case with complainants' valve, this moderation being necessary for practical braking.

I will refer to the experiments I made, where the ring 9 of defendants' valve was removed, and the ports in the valve 18 were suppressed by being plugged up. The possibility of quick action was removed, as there was no restricted passage between the auxiliary reservoir and the brake-cylinder, and service application of the brakes could only be made through the auxiliary port controlled by the valve 22, which is normally used for quick action. With that modification, the brakes applied forcibly, and in a manner which the defendants' devices cannot be made to operate, when they are in their normal form as quick-action triple valves.

690 Q. In the construction shown by the tracing "Complainants' Exhibit Westinghouse Modification," what, if any, function is performed by the valve recess, or extended port opening *x*, in any operation whatever of the construction as a triple valve proper known prior to 1887, and what, if any, additional function or office is imparted to the port 31 controlled by the graduating valve, by the addition of such valve recess or extended port opening?

A. The valve recess or extended port opening *x* has no
619 office whatever, during the performance of any of the three functions of triple valves known in the art prior to 1887.

The addition of the valve recess or extended port opening *x* increases the function of port 31 by causing it to act and perform the office of a restricted passage between the auxiliary reservoir and the brake-cylinder, such as is performed by port 35 of complainants'

valve, and port B of defendants' valve, to enable the auxiliary or quick-action function to be performed.

Adjourned to Monday, January 8, 1894, 10.30 a. m.

NEW YORK, *January 8, 1894*—10.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of D. L. BARNES resumed:

691 Q. It is stated in defendants' 1891 catalogue, page 29, referring to defendants' quick-action triple valve, plate XI, that:

"The actions of this valve in graduating, full-service application, quick action and the release, are the same as the new Westinghouse quick-action valve, thereby producing the same result in braking, which renders cars equipped with the two valves perfectly interchangeable—the hose couplings being the same."

Assuming such statement to be true, what would be the necessary and inevitable operation of the defendants' device, when used on a car or cars of a train containing other cars equipped with the quick-action triple valve of patent 360,070?

620 A. I understand that the statement in the question, which is an extract from defendants' 1891 catalogue, refers to the present standard quick-action triple valve of the Westinghouse Air Brake Company, which is a device similar to that shown and described in the drawings and specification of patent No. 376,837, granted to George Westinghouse, Jr., January 24, 1888, but as this device is like the device described and shown in the drawing and specification of patent 360,070, in that the auxiliary valve for the performance of the auxiliary or quick-action function is actuated by the further traverse of the triple-valve piston, and as these valves operate to produce identically the same practical results in practically the same way, the statement in defendants' catalogue, quoted in the question, refers, in effect, to the practical operation of either of the devices shown in the two Westinghouse patents I have mentioned.

The necessary and inevitable operation of defendants' device, when used on a car or cars of a train containing other cars equipped with the quick-action triple valve of patent 360,070, would be the performance of the four functions of quick-action triple valves, not only in the same successive order and under the same conditions, but also coincidentally in time, and identically in *degree* of performance of the said four functions, that is:

The first function of charging must be the same in *degree*, and take place with the same increase of pressure in the train-pipe, and be performed in practically the same time, otherwise practical difficulties would arise. It has been found necessary for the committee recently appointed by the Master Car Builders' Association, to define the degree of the performance of all of the four functions of quick-action triple valves, in order to get the necessary uniformity

to make the results of both the service and emergency braking practically useful.

The service application must be performed in the same *degree*, or there will be serious shocks in the train for the reasons that I have previously set forth.

621 The release of the brakes must be performed with practically the same *degree*, or there would be a delay in releasing the brakes, or some of the brakes would be released before they should, and there would arise practical difficulties in operation.

The fourth, or auxiliary, function of quick-action triple valves, must be performed to practically the same *degree*, and in the same time, or the most disastrous results will occur in making emergency application.

Therefore, it is essential that defendants' valve, like all other practical quick-action triple valves, shall operate in conjunction with the complainants' valve, in the essential way that has been determined by the Westinghouse Air Brake Company as necessary for the practical and safe operation of quick-action brakes on trains.

It is this which has led me to a positive conviction that, as shown by the experiments I have performed, there is no difference in the degrees of performance of the second function of triple valves prior to 1887, in practical operation, between defendants' and complainants' valves.

692 Q. In his answer to R. D. Q. 238, Mr. Boyden states that in making a quick-action application of the brakes with the appliance of patent 360,070, a greater amount of air pressure would be admitted to the brake-cylinder through the port 35, than through the port 42, which is controlled by the valve 41. Do you, or not, accord with this view?

A. The relative amounts of air, and by this I mean the weights of air, (for evidently the pressure and volume vary too much to be used as a basis of comparison), that enter through the ports 35 and 42 of complainants' valve, depend upon the travel of the piston in the brake-cylinder. In average practical conditions, a greater weight of air enters through the port 42, when quick action is performed. In some cases, practically the same amount in weight enters through the two ports.

The substantial assistance which is obtained from the performance of the auxiliary function by complainants' valve, and by quick-action triple valves generally, in the way of a more powerful application of the brakes, and in saving air pressure, and in emptying the train-pipe, is shown by this answer, and indicates the value of the improvement in braking devised by Mr. Westinghouse and set forth in the specification of patent 360,070, and which has rendered possible the use of powerful brakes on long trains, which it was impossible to do prior to 1887.

693 Q. I understand the statements of Mr. Church, in folios 851 to 853, on page 213, and first paragraph of page 214 (D. R.), to the effect that the results produced by the valve 41 and port 42 of the appliance of patent 360,070, are produced, in defendants' devices, directly by the triple valve proper, and that Mr. Boyden has suc-

ceeded in making a triple valve proper perform the operation of quick action, without the addition of anything corresponding in name, construction, or mode of operation, with said valve 41 and port 42, to be, in substance, repeated and summarized in Mr. Church's answer 12, the errors of which you have heretofore indicated.

In order that your position, as to the above two statements of Mr. Church, may be clearly stated, I will now ask you whether or not said statements of Mr. Church are true and correct statements?

A. They are not true and correct statements, as I have set forth in detail in answer to a preceding question.

Mr. Church has said that

"Mr. Boyden has succeeded in making a triple valve perform the operation of admitting train-pipe air directly into the brake-cylinder without interfering with its functions as a triple valve proper and without the addition of anything corresponding in name, construction, or mode of operation with the auxiliary valve."

I notice that Mr. Church did not say this result had been secured by Mr. Boyden "without the addition of anything corresponding in" *function*. Manifestly, the "name" of a part is not necessarily descriptive of its function. The construction is, in a general way, identical in complainants' and defendants' valves, while in detail it differs materially. The "mode of operation" is absolutely identical in the two devices, as I have explained in detail heretofore, and it is not necessary for me to rehearse the reasons here. Mr. Church has said "in the complainants' patent in structure, *two valves are required* for effecting an emergency application of the brakes." The untruthfulness of this statement is shown by Mr. Boyden's experiment with the device shown in drawing No. 10, by which it was proved by Mr. Boyden that two valves are *not* required. I have before explained in detail, that the auxiliary function, namely, quick action, may be quite as well performed by an auxiliary valve, which may be a part or parcel of any other part or valve. A detailed explanation of this I have given in a preceding answer.

694 Q. To what extent do you find the comparative statements of the "valves or valve functions," in the structure of patent 360,070 and in defendants' structures respectively, made by Mr. Church on page 214 (D. R.) to be true and correct statements?

A. Mr. Church's statements are untrue and incorrect, because he has attempted to describe functions by enumerating the names of parts, which is manifestly incompetent. Whatever the number of parts or the names of the parts be, or are, whether more or less, the function of quick-action triple valves, as has been set forth in defendants' 1891 catalogue, and by Mr. Boyden in answer to X Q. 152, and in answer to Q. 9, and as set forth in a preceding answer by me, are four in number, namely, the three functions of triple valves prior to 1887 and the auxiliary, fourth, or quick-action function; there are no other functions.

695 Q. Mr. Church states, on page 215 (D. R.), that in the device of patent 360,070, "it is requisite and necessary that the aux-

624 liary valves should be moved by the piston to uncover a port for the admission of train-pipe air to the brake-cylinder, whereas in defendants' structures, there are no auxiliary valves," etc. To what extent is this statement a true and correct one?

A. The statement in question is untrue and incorrect, except as to his statement that "it is requisite and necessary that the auxiliary valve should be moved by the piston to uncover a port for the admission of train-pipe air to the brake-cylinder." The correctness of this part of Mr. Church's statement needs no argument, as it is precisely what is described in the specification of patent 360,070.

The incorrectness of Mr. Church's statement lies in the fact, that he says that what is one of the most essential features and characteristics of defendants' valves does not exist in that valve. Clearly, from the construction, the piston opens an auxiliary valve, which admits air from the train-pipe to the brake-cylinder for the performance of the auxiliary function, upon the further traverse of that piston, and the auxiliary valve of defendants' valve has no other function than the performance of the auxiliary function, hence the error in Mr. Church's statement, which is not a statement of facts.

696 Q. From your observation of a repetition of the experiments made by Mr. Boyden, as well as from those made by yourself, state whether or not you find the opinions and conclusions expressed by Mr. Church in his answer 13, commencing with folio 914, p. 229, (D. R.) as to the Boyden experiments, to be warranted or well founded?

A. They are neither warranted nor well founded, either upon logical reasoning or upon facts developed by the experiments.

I have shown, in a preceding answer, that the "principle of momentary differential pressures" is as old as triple valves in the art, and that it is not new, and was not invented by Mr. Boyden, so far as the records of the art are competent to show this. All triple valves, whether plain or quick-action, depend upon "the principle of momentary differential pressures" and "restricted passages" for their operation.

697 Q. Referring to the drawings, "Complainants' Exhibit Illustrations," please explain what the same represent, so far as you may consider such an explanation to be necessary or desirable to facilitate an understanding of the drawings by the court?

A. Drawings No. 1 to 22 inclusive, are marked with titles which indicate the meanings of the drawings, and probably no further explanation is necessary.

The remaining drawings will explain more clearly some parts of my testimony, and therefore a further description may be useful.

Drawing No. 23 illustrates the "triple valve proper" part of defendants' 1891 valve. In this device, in which the valve 22 has been suppressed, so as not to be operative, the first function of charging, and the third function of release, are performed when the parts are in the position shown in drawing No. 23, while the second function of admitting auxiliary reservoir pressure to the brake-

cylinder is performed when the parts are in the position shown in drawing No. 24, in which, as well as in drawing No. 23, the auxiliary valve 22, for the performance of the auxiliary function, has been suppressed. As I have shown by experiment, cited in a preceding answer, all the functions of a "triple valve proper" are satisfactorily and completely performed by the device as shown in drawings No. 23 and No. 24, without the auxiliary valve 22, which shows that the auxiliary valve 22 has no useful purpose in the performance of any of the three functions of a "triple valve proper." It also is shown that the further traverse of the piston, which is suppressed in drawings 23 and 24, has no useful purpose in the performance of the three functions of a "triple valve proper."

Drawings No. 25 and No. 26 show the equivalence of the auxiliary valve 22 of defendants' valve and the auxiliary valve 626 41 of complainants' valve. Valve 22, in this construction, is operated in the same way, and has the same location with respect to other parts, so far as practical operation is concerned, as in defendants' valve. This construction has the parts belonging to the "triple valve proper" function of complainants' valve. In this construction, port 35, the restricted passage, has been removed, as port B is its identical equivalent, as I have before explained, and this serves to illustrate that explanation.

Valve 22, identical with valve 22 of defendants' valve, is actuated by the further traverse of the piston to perform the auxiliary function, just as in defendants' valves. In this construction, it is evident that none of the three functions of a "triple valve proper," are performed by the valve 22, any more than in complainants' valve they are performed by valve 41. This drawing serves to illustrate the fact that no function is performed, by complainants' valve, that is not also performed, in the same way, by defendants' valve.

Drawing No. 26 differs from drawing No. 25, in that the restricted passage B, corresponding to the restricted passage 35 of complainants' valve, is differently located, and forms, together with the passage uncovered by the valve 22, upon the further traverse of the triple-valve piston, the essential differential passages characteristic of all quick-action triple valves, which are exemplified by the differential passages 35 and 42 of complainants' valve.

Drawing No. 27 illustrates, even more forcibly, the equivalence of passage B of defendants' valves and restricted passage 35 of complainants' valve, as this construction, drawing No. 27, differs from the construction of drawing No. 26, only by the suppression of the restricted passage B, drawing No. 26, and the insertion of the restricted passage 35 of complainants' valve. It is evident from these drawings, that restricted passage 35 of complainants' valve, and restricted passage B of defendants' valves, have identically the same function, which is to form, together with the larger and more 627 capacious passage leading from the train-pipe to the brake-cylinder, the "differential passages" essential for the practical operation of quick-action triple valves.

698 Q. Will you please produce and explain a drawing illustrating the application of quick-action brake apparatus to freight cars,

and the relation of the apparatus of one car to that of others of the train?

A. The three cars shown on the lower part of the drawing, which I produce, illustrate in detail the location of the apparatus on individual and succeeding cars of a train, and show how the devices work in series. Each car is provided with a train pipe from end to end, with the necessary stop-valves, hose, and couplings. Near the centre of the car is located the brake-cylinder and auxiliary reservoir, which are placed tandem. On the end of the auxiliary reservoir, there is located a quick-action triple valve, which is connected to the train-pipe by a branch pipe, as shown. A strainer is provided at the joint between the branch pipe and the train-pipe, to prevent grit and dirt reaching the quick-action triple valve.

In operation, during the performance of the auxiliary or fourth function, namely, quick action, the air taken from the train-pipe and admitted to the brake-cylinder, reduces the pressure in the train-pipe, and, by this reduction, the next succeeding brake is applied with quick action, thus further reducing the pressure and again applying the next succeeding brake, and so on throughout the train. This action proceeds through a long train with practically the rapidity of the velocity of sound, a velocity of application wholly unknown prior to 1887. The time occupied in applying all the brakes in a train of fifty cars, which is about three-eighths of a mile long, is less than two seconds from the front to the rear car.

At the top of the drawing which I produce, is shown a train of fifty cars, with a caboose at the rear and a locomotive in front. A train of this kind has the following dimensions:

Total weight about 2,000,000 pounds.
628 Total length about 1,900 feet.
Total length of each car, about 38 feet and 4 inches.

Capacity of each car for freight, 60,000 pounds.

Capacity of total train for freight, 3,000,000 pounds or 1,500 tons.

Total weight of loaded train, 5,000,000 pounds or 2,500 tons.

Prior to 1887, it was not safe or practical to run a train of this kind, or even a much shorter one, with the air brakes then in use, owing to the severe shocks produced in the train. It was not possible to use the plain triple valve, known prior to 1887, with a high degree of performance of the second function, that is, by opening a large passage from the auxiliary reservoir to the brake-cylinder, for the reason, that the brakes on the front of the train apply so much quicker than those on the rear, that the front of the train would be slowed down, and the rear would run into it and produce serious damage, not only to the freight, but to the train itself. It was the object of Mr. Westinghouse, in devising the quick-action triple valve described in the specification and drawings of patent 369,070, to decrease the time required to apply the brakes, so as to bring the brakes on the rear into action almost simultaneously with those on the front of the train. In 1887, it was pronounced by the committee of the Master Car Builders' Association, that a sufficiently quick-acting brake for a fifty-car train could not be wholly actuated by air, as up to that time no wholly air brake had been produced that

could be practically used for making quick stops with safety on long trains. Mr. Westinghouse equipped a train of fifty cars with a quick-action brake, in which the fourth, or auxiliary, function of admitting air from the train-pipe to the brake-cylinder was performed, and made numerous experiments, many of which I witnessed. Two of the most useful results that were shown by these experiments were the following:

With the plain brake, on twelve passenger cars equipped as prior to 1887, at a speed of 40 miles an hour, it required 862 feet to make a stop, while with 20 freight cars, equipped with quick-action triple valves, a stop was made in 459 feet. These results are the average of many experiments.

With a fifty-car train, such as shown on the drawing, running at 20 miles an hour, it required 1,800 feet to make a stop with hand brakes, while, with the same cars, using the quick-action triple valves, a stop was made in 100 feet. The great increase in safety that resulted from the use of quick-action triple valves, is apparent, as it was found impossible to use a plain triple valve with a forcible action on long trains.

Another important result from these experiments, was the illustration of the fact, that with quick-action triple valves, a train can be broken in two parts without danger of the parts coming together and causing a wreck.

Counsel for complainants offers in evidence the drawing referred to by witness, and the same is marked "Complainants' Exhibit Drawing Quick-action Automatic Freight Brake."

699 Q. Referring you to the Westinghouse patent No. 217,838, to what extent, if at all, do you find the device therein set forth to be adapted to practical railroad service in an automatic air-brake system?

A. It is not at all applicable, for the plain reason that it could not be used practically. Such a device so obstructs the feeding or charging process as to prevent its practical application to practical trains.

It would be impossible to graduate the brakes in a service application, so as to make the necessary difference in the force of applying the brakes.

The reasons for the inefficiency of this device in release, in charging, and in service application, are as follows:

In order to charge the brakes, the valve E must be lifted against the spring e. This resistance is greater than can be allowed in service, and would result in the charging of only a few brakes at the front of the train.

In the application of the brakes, the piston D would move down, until a passage was opened from the train-pipe on one side, past the point s, and through the port C, which would result in the train-pipe being wholly emptied, and would entirely destroy the brakes for service application and graduation.

In releasing the brakes, the air coming from the main reservoir on the engine has but little velocity and impulse, not enough prac-

tically to push the piston D back to close the passage past the point s, and, therefore, the charging air would go out through the port C and the brakes would not be charged. Again, if, in some cases, the piston D did return to the position shown in figure 1 of the patent in question, then the releasing pressure would have to operate against the spring e, and it would be impossible to release the brakes, on any but the first few cars, with a rapidity sufficient for practical operation.

700 Q. In the specification of patent 360,070 (lines 94 to 99, page 4,) I find a reference made to

"a construction in which 'an always-open one-way passage' from the main air pipe to the brake-cylinder is uncovered by the piston of the triple valve simultaneously with the opening of the passage from the auxiliary reservoir to the brake-cylinder"

as being a construction which had been proposed prior to patent 360,070.

As you understand the construction referred to in the extract from the specification above quoted, do you or not, find a similar or equivalent construction in either of the defendants' quick-action triple valves in this suit?

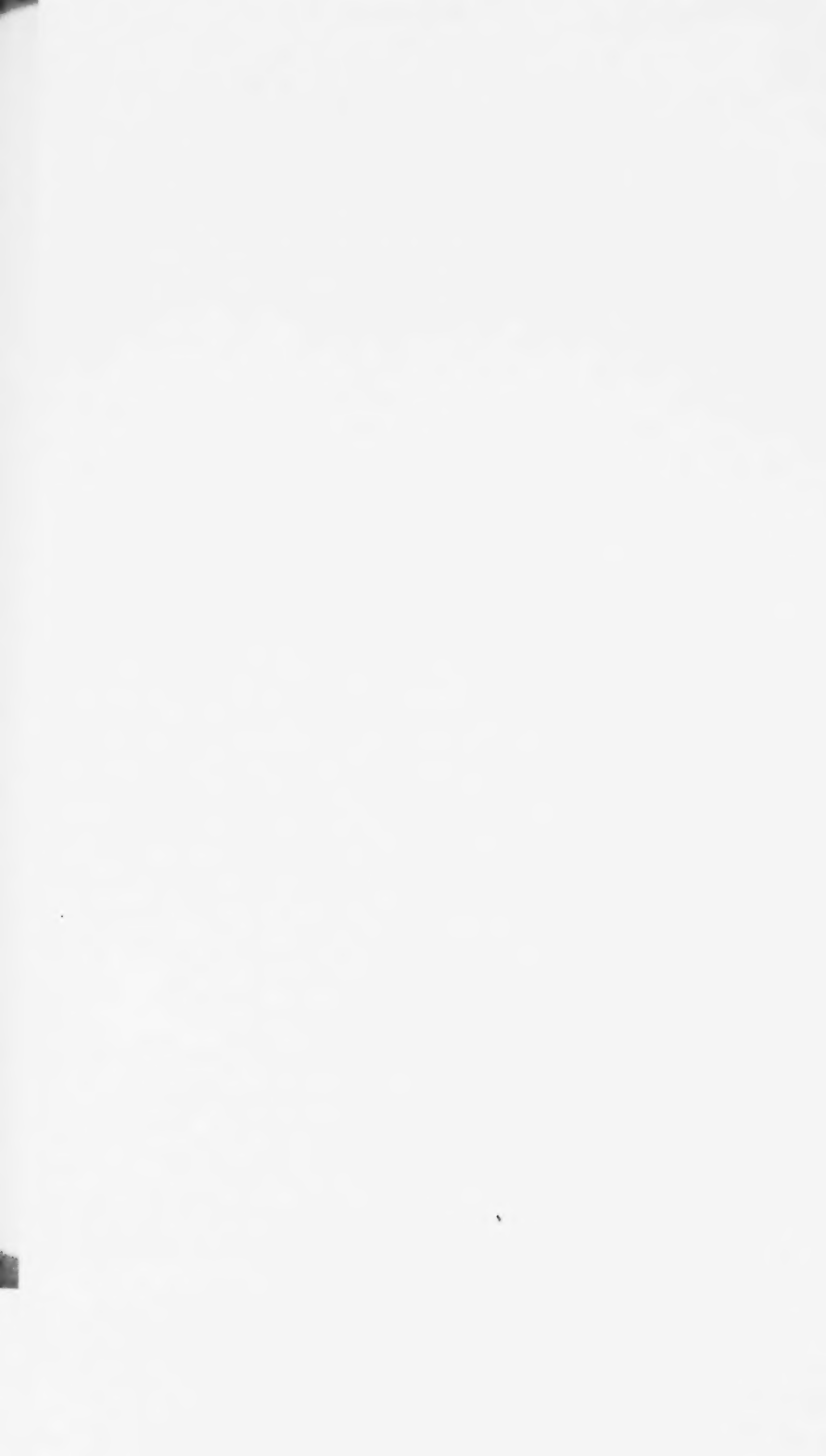
A. I do not find any construction in either of the defendants' quick-action triple valves which answers to the description quoted in the question.

631 701 Q. I understand the defendants' witnesses to allege and claim that defendants' structures operate on a "new principle," by the employment of "differential passages," and I also understand from your testimony that the appliance of patent 360,070 employs differential passages of corresponding functions. What would be the effect of doing away with the differential relation of said passages in the appliance of said patent 360,070?

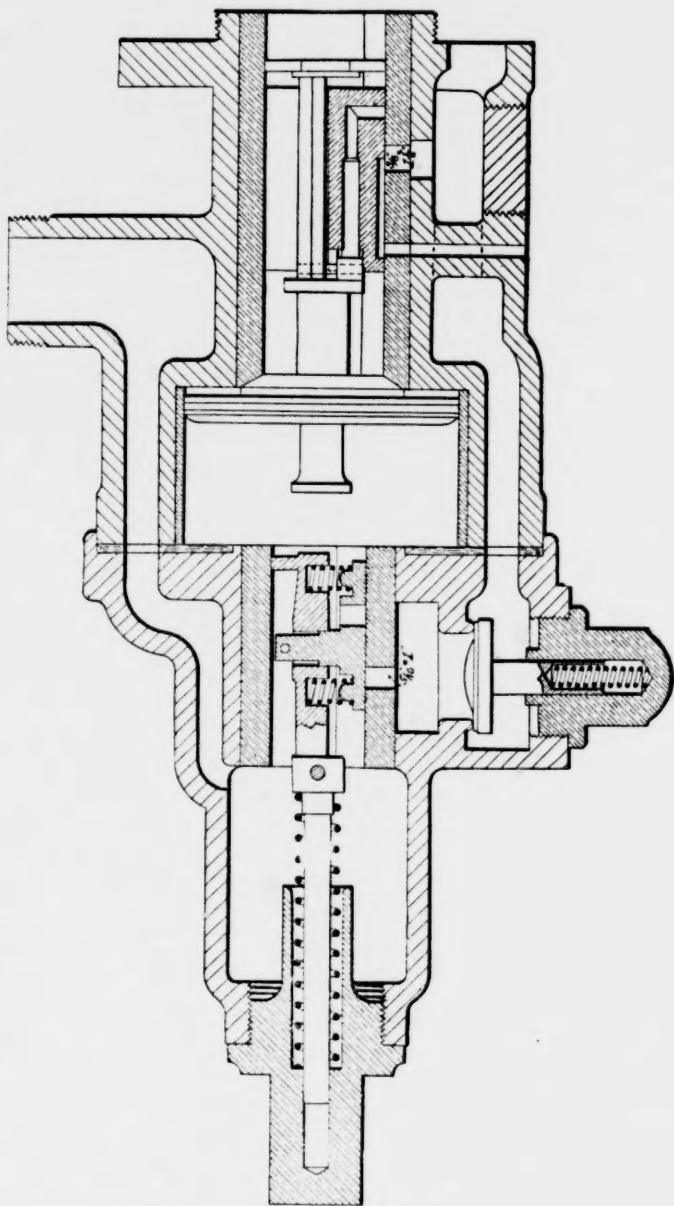
A. I have explained in a preceding answer, and described experiments which add to that explanation, how the removal of differential passages resulted in destroying the auxiliary or quick-action function of quick-action triple valves.

The removal of the ring 9 of defendants' 1891 valve destroys the differential passage B, just as the removal of the ring 9 destroyed the differential passage B of the combined Westinghouse and Boyden valve shown in drawing No. 10, defendants' "illustrative cuts," and just as the enlargement of the port 35, or its equivalent, would destroy the quick-action function of the device of patent 360,070.

I produce a drawing showing a modification of complainants' valve, in which there is no restricted passage between the auxiliary reservoir and the brake-cylinder upon the further traverse of the piston; therefore the quick action is destroyed, because the pressure from the auxiliary reservoir reaches the back side of the check-valve, and prevents its opening by the lower train-pipe pressure, as I have described in detail in a preceding answer. I have added two dotted lines to the blue print, to show that the passage leading to the brake-cylinder is connected with the passage in which the check-valve is located.



Complainants' Exhibit "Westinghouse Device without Differential Passages."



The blue print produced by the witness is offered in evidence by counsel for complainants and is marked "Complainants' Exhibit Modification Westinghouse Device without Differential Passages."

(Here follows diagram marked p 630a.)

632 702 Q. You have, in your previous testimony, referred to an "integral" construction of the main and auxiliary valves of a quick-action triple valve. In what, if any, essential or characteristic features of practical operation, would, or does, such integral construction differ from the appliance described in patent 360,070?

A. It does not differ in any essential feature or characteristic; but performs the same four functions of quick-action triple valves, and produces the same practical result. This I have shown in my answer describing the experiments with the device shown in drawing No. 10, defendants' "illustrative cuts," which is an example of the integral construction of the main and auxiliary valves of quick-action triple valves.

In the integral construction, the further traverse of the triple-valve piston opens an auxiliary valve to admit air from the train-pipe to the brake-cylinder, for the performance of the auxiliary or fourth function, exactly and precisely as is done in the device described and shown in the drawings and specification of patent 360,070.

703 Q. In what, if any, essential or characteristic feature of practical operation, would, or does, such an integral construction differ from the defendants' quick-action triple valves of plate IX defendants' 1889 catalogue and plate XI defendants' 1891 catalogue?

A. It does not differ in any essential feature or characteristic, or in function, nor would it produce any different result, in practical operation, from those which are produced by defendants' 1889 and 1891 valves.

This is fully shown by my recital of the experiments made with the device shown in drawing No. 10, defendants' "illustrative cuts," which illustrates an integral construction, and which operates identically with the operation of defendants' 1889 and 1891 valves. In

633 both, and all, of these valves, the further traverse of the triple-valve piston actuates an auxiliary valve, which admits air from the train-pipe to the brake-cylinder to perform the fourth or auxiliary function.

704 Q. I understand the defendants' witnesses to allege and claim, in substance, that the defendants' structures are simply plain triple valves, as used prior to 1887, and having the general characteristics of the device of patent 220,556, but with the addition of differential passages.

Please state whether or not such allegation and claim is well founded or warranted, and, in your answer, make such a comparison of the structure of patent 220,556 with the defendants' structure, as may be necessary to make your meaning clear.

A. I do not consider that such claim is warranted or well founded, for the following reasons:

First. The valve shown and described in the specification of patent 220,556 has but three functions, while complainants' valves have four functions.

Second. The device of patent 220,556 has a wide variation of performance of the second function of plain triple valves, while defendants' valves have not, as I have shown by experiment.

Third. The device shown in patent No. 220,556 has no passage directly from the train-pipe to the brake-cylinder, while defendants' valves have such passages.

Fourth. The device shown in patent 220,556 has no auxiliary valve which controls the passage leading from the train-pipe to the brake-cylinder, while defendants' valves have such passage.

Fifth. Device shown in patent 220,556 has no further traverse of the piston which opens an auxiliary valve which controls the passage leading from the train-pipe to the brake-cylinder, while defendants' valves have such a further traverse which performs the said office.

Sixth. The device shown in patent 220,556 has no check-valve for the purpose of retaining train-pipe pressure in the brake-cylinder when that pressure has once entered the brake cylinder, while defendants' valves have such check-valve for said purpose.

634 Seventh. The device shown in patent 220,556 has no restricted passage between the auxiliary reservoir and the brake-cylinder, to withhold the auxiliary reservoir pressure, so it cannot enter and suffocate the check-valve and prevent its opening by the lower train-pipe pressure, while the defendants' valves have a restricted passage for said purpose.

Eighth. The device shown in patent 220,556 has no differential passages, such as are essential to all quick-action triple valves to enable the train-pipe pressure to enter in a large amount before the pressure enters the brake-cylinder from the auxiliary reservoir, so that the train-pipe may be emptied and quick action produced, while defendants' valves have such differential passages.

705 Q. In the specification of the Boyden patent, No. 481,134, which patent Mr. Boyden admits, sets forth a quick-action triple valve, similar in all essentials, to that of plate IX defendants' 1889 catalogue, I find (lines 86 to 95, page 5) the following statement:

"It will be seen that my present invention for introducing train-pipe air into the brake-cylinder for emergency stops differs essentially from the device shown in the said patent No. 360,070, because I have provided a new principle of construction and a new mode of operation, by use of which the desired result aforesaid may be produced without the aid of the auxiliary valve heretofore required for the purpose."

In the specification of the Boyden patent No. 481,135, which patent Mr. Boyden admits, sets forth a quick-action triple valve, similar, in all essentials, to that of plate XI defendants' 1891 catalogue, I find (lines 73 to 79, p. 1) the following statement:

"It will be seen that the means I have thus provided for
635 introducing train-pipe air into the brake-cylinder for emer-

gency stops differs, essentially, from that shown in said patent No. 360,070, and that said means involve a new mode of operation."

To what extent, if at all, are the above statements true or correct statements of fact?

A. The statements quoted in the question are not true or correct, for reasons that I have set forth at length in my testimony, when referring to defendants' valves corresponding with those of the respective patents mentioned, and it is not necessary for me to describe the errors in the statements again.

706 Q. In the specification of the Boyden patent No. 481,134 I find that the valve F, shown in the drawings, is termed throughout the "main" valve.

Please state whether or not such designation of the valve F of this patent is a correct one?

A. It is not a correct designation of valve F, for the reasons that I have given in answers to several preceding questions relating to valve 15 of the device of plate IX defendants' 1889 catalogue. The valve F, shown in the drawing of the patent, is the same as valve 15 of this plate.

As I have before explained, in speaking of the valve 15, the valve F performs none of the main functions of braking, and is used only to perform the auxiliary, fourth, or quick-action function.

707 Q. In the specification of the Boyden patent No. 481,135 I find that the valve 22, shown in the drawings, is termed the "main" valve.

Please state whether or not such designation of the valve 22 of this patent is a correct one?

A. It is not a true and correct designation of valve 22, as I have shown in replies to several preceding questions, wherein I referred to the valve 22 of plate XI defendants' 1891 catalogue. The valve 22 of patent No. 481,135 is the same as the valve 22 of this plate.

As I have before explained in speaking of valve 22, that valve performs none of the main functions of braking and is used only to perform the auxiliary, fourth, or quick-action function.

708 Q. In a portion of the specification of the Boyden patent No. 481,135 which purports to describe the "operation" of the appliance of said patent, I find that it is stated that "the brakes may be applied fully in two ways: first, by the auxiliary reservoir pressure alone, and, second, by the auxiliary reservoir pressure in conjunction with the train-pipe pressure" (lines 79 to 84, p. 3).

The specification also says "to apply the brakes fully for an ordinary stop, a limited amount of train-pipe air is continuously discharged from the engineers' valve" etc., and goes on to describe the alleged operation which thereupon takes place (lines 88 to 121, p. 3).

To what extent, if at all, are the statements above referred to, as to the alleged operation of the appliance of patent 481,135, true and correct in fact?

A. The statement is not correct in fact, as I have shown in reply to a preceding question, when describing experiments made with

the device shown in plate XI of defendants' 1891 catalogue, in which device valve 22 is the same as the valve 22 of the device shown and described in patent 481,135.

I have shown that the valve 22 cannot be lifted or opened, for the application of the brakes with auxiliary reservoir pressure, without at the same time producing quick action. In fact, valve 22 of these devices has no other office or function than the performance of the auxiliary, quick-action, or fourth function, of quick-action triple valves, and this I have so fully set forth that it is not necessary to do it again.

Adjourned to Tuesday, January 9, 1894, at 10 a. m.

637

NEW YORK, *January 9, 1894*—10 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of D. L. BARNES resumed :

Counsel for defendants states that, as will appear from the record, this witness has been examined as "a practical expert in the art of automatic brakes for railroads," and as "a mechanical engineer familiar with air-brake practice." The witness has shown himself to have no experience in connection with questions relating to letters patent for inventions, and to have no qualifications which make him competent for explaining the scope of letters patent.

Counsel for defendants, therefore, objects to each and all of the several statements and arguments made by this witness, where, as a person experienced in questions relating to letters patent, he has expounded or attempted to expound, the scope of the specification of complainants' patent in suit, No. 360,970, in disregard of, and without reference to, the limitations and restrictions of said patent. The objectionable statements now referred to are found in answers to questions 667, 672, 673, 675 and others, and this part of the testimony is objected to because the witness is not competent to give such testimony.

Counsel for defendants does not, of course, object to that part of the testimony of the witness, where, as a mechanical expert, he has explained the constructions shown in complainants' said patent 360,970 and the mode of operation of such constructions.

Counsel for complainants again asks the attention of the court to the fact that this witness has not been asked to explain, and
638 has not assumed to explain, "the scope of letters patent," and also to the apparent inability of defendants' counsel to understand that the specifications of letters patent, like any other specifications of mechanism, are technical descriptions, addressed to practical men familiar with the arts to which they relate, and that the testimony of such practical experts, in relation to the construction and mode of operation, or principle of operation, of the mechanisms to which such technical descriptions relate, is competent in the fullest sense. It is, therefore, submitted that the objections of

defendants' counsel, if they mean anything, are directed, not to what the witness has said, but to what the witness has sedulously avoided saying.

Cross-examination *de bene esse* by CHARLES B. MANN, Esq., of counsel for defendants, reserving exceptions taken:

709 X Q. Please state when, where, and by whom you were duly sworn as a witness to testify in this cause?

A. On the evening of Wednesday, December 13th, 1893, in the city of Allegheny, Pennsylvania, by Mr. F. E. Gaither, the examiner in this case.

710 X Q. You have referred to Mr. Boyden's statement in folio 75, p. 19, (D. R.) and have drawn a distinction, or attempted to draw one, between the meaning of the word "*additional*" and the word "*auxiliary*," as Mr. Boyden used them when describing the *essential features* of complainants' device of patent 360,070. I now ask you what warrant you have for making any distinction as to the meaning of these words used by Mr. Boyden?

Objected to as already answered; the witness having given, in his deposition-in-chief, his reasons and warrant for making the statements which he did make.

639 A. I was asked, Q. 667, to what extent I agreed with Mr. Boyden's statement in folio 75, p. 19, (D. R.) as to the essential features of the quick-action triple valve shown and described in the specification and drawings of patent 360,070, and I was compelled to call attention to the unwarranted use of the term "*additional*," in order that my answer might be a true and correct one.

I understood that I was in the position of one skilled in the art of braking, and was asked to explain what is absolutely essential in a quick-action triple valve, in order that it may correspond to the specification of patent 360,070, and this I did by explaining that it was essential that there should be an auxiliary valve, actuated by the further traverse of the piston, for the performance of the auxiliary or fourth function, as is distinctly set forth in several places in the specification. The auxiliary valve may be, as the term "*auxiliary*" implies, a part or parcel of any other part of the mechanism, but its function must be auxiliary, and it must be actuated by the further traverse of the piston. Manifestly, the number of constructions to fulfill the specification of the patent is very great, and the drawings of the patent show one of these constructions. I am accustomed to building mechanisms from specifications, and the foregoing is my warrant for making the reply that I did.

711 X Q. You say that you were compelled to call attention to the unwarranted use of the term "*additional*." Why do you state that the use of this word is unwarranted?

Same objection.

A. Because it does not state the fact, with reference to the specification of patent 360,070, and implies a meaning that is not an es-

sential or characteristic feature of the specification of patent 360,070. As I have said before, it is only essential that the part in question shall be "auxiliary," which is a term referring to the function, and not to the integrality.

640 712 X Q. My question 711 did not ask what was the essential or characteristic features of the specification of patent 360,070, but why you stated that the use of the word "additional" was unwarranted. Please to answer this question?

Objected to as fully answered in reply to X Q. 681, in which the witness stated specifically why he was compelled to call attention to the unwarranted use of the term "additional."

A. It is unwarranted because it does not state the fact with reference to the specification of patent 360,070, and further, it is unwarranted because it implies a meaning that is not an essential or characteristic meaning or feature of that specification, as I have several times before explained in detail.

713 X Q. In your answer to Q. 667, you made this statement: "I cannot find the term 'additional' used in the specification and description of patent 360,070."

I will now quote from the specification of that patent, p. 3, line 39, as follows:

"So far as hereinbefore described, the triple valve accords in all substantial particulars with, and is adapted to operate similarly to, those of my letters patent Nos. 168,359, 172,064 and 220,556, and in order that it may perform the further functions requisite in the practice of my present invention, it is provided with certain additional members, which will now be described."

As it is plain from the matter just quoted that the term "additional" is used in the specification of patent 360,070, although you failed to find it, I now ask you if you will not admit that you were mistaken?

A. No, for in the question the quotation reads "certain additional members" in which the term additional is distinctly explained and modified by the term members. I now quote from the Century Dictionary on this point:

"An integral part of an animal body having a distinct function."
"A part of an aggregate or whole."

I did not consider that the term "additional," as there used, meant "separated," and I now see, by reference, that I was right, and this is the explanation which, added to my answer to Q. 667, would have made it perhaps more intelligent, but as the answer was a long one, I was led to contractions. This is the reason why I have answered "no," to this question. Manifestly, no device differing so much in function as the devices shown and described in patents Nos. 220,556 and 360,070 can be made without "additional" members, the one over and above the other, but as I have explained, and as the terms distinctly and clearly specify, the parts need not be separated, but may be or may not be a part of the same integral or whole of any part.

714 X Q. Then you say that, although the word "additional" is

used in the specification of complainants' patent, and in your answer to Q. 667 you said, without any reservation whatever:

"I cannot find the term 'additional' used in the specification and description of patent 360,070,"

yet, notwithstanding this discrepancy, you say that you were not mistaken. Is this so?

A. I was certainly not mistaken as to the unwarranted use of the term "additional," as implying separation, and I have explained, in my answer to X Q. 713, how my answer to Q. 667, in the part which you have quoted, is to be understood.

Answer objected to as not responsive to the question.

642 715 X Q. You made the statement, that the term "additional" could not be found in the specification of patent 360,070. I have pointed out that term as being in line 46, page 3, of the specification, and I asked you if, in making the statement that you did, that you could not find it, you were not mistaken, or had not overlooked it, and your answer to that question was "no." Now I ask you how you reconcile that answer with the facts?

Objected to as misstating the witness' testimony, he not having answered merely "no," as is directly implied in the question, but having, as a matter of fact, commenced his answer with the word "no," and continued by giving his reasons.

A. My answer taken as a whole, is in perfect accordance with the facts. I have frankly confessed in answer to X Q. 713, that my answer to Q. 667 would be more explicit, if to it had been added the explanation given in answer to X Q. 713, as in answering Q. 667 I was referring to the use of the term "additional" in the sense of being "separated," and, as I have explained, it is not there used in that sense, but in distinctly another sense, as it is specifically explained by the term "members," and this is the way in which I wish my answers to be reconciled with the fact.

716 X Q. You say "I have frankly confessed" that my answer would be more explicit, if to it had been added the explanation made in answer 713. What I want to ask you now, is whether you will not frankly confess that in making the statement unqualifiedly, that you could not find the term "additional" in patent 360,070, you were mistaken, or had overlooked the fact, that the word was there?

A. I will now quote what I said in answer to Q. 667, and will then show that I was not mistaken, and therefore have no confession of mistake to make, and again add, that my answer to

643 Q. 667 would be more explicit, if it was explained as I have done in answer to X Q. 713; but I do not yet see how there need be any mistake or misunderstanding of my answer, because, in the same sentence, with the part of my answer which has been quoted in X Q. 713, I explained right there, with the statement quoted, the "sense" in which I was referring to the term "additional." I now quote what I said on this point:

"In conclusion then, as to the use of the term 'additional' by Mr. Boyden, *in the sense of being separated in structure*, the term is indefinite and I do not find it mentioned in the description of the device shown in patent 360,070, and it is not necessary for the full performance of all of the four functions of the quick-action triple valve shown in that patent, that there be any additional valve, in the sense of being separated as to structure."

I do not see how this can be misunderstood, as the "sense" in which I was using the term "additional" was fully explained. The error that is apparently in the mind of the counsel is, that my full answer has not been read as an entirety, but, instead, the specific statement, without the explanatory parts in the same sentence, has been selected. With the explanatory part, and with my further explanation in answer to X Q. 713, my meaning is complete, and it is clear that I was not mistaken.

717 X Q. I do not think that there is any error in my mind about this matter. You distinctly stated at the outset of your answer 667 "I cannot find the term additional used in the specification and description of patent 360,070. I quote from the specification of patent 360,070, p. 4, line 20." Now I ask you to point out to me any qualification whatever, with respect to your statement just quoted.

A. The qualification will be found in my answer to Q. 667, following immediately upon the quotation just given in this 644 question, which shows clearly that I was referring to the term "additional" in the sense of being "separated." The explanation reads, "the term 'additional' as used by Mr. Boyden carries with it a sense of separation." I have already explained wherein my answer to Q. 667, which is a long answer, could be more explicit, if added to and further explained, as I have done in answer to X Q. 713, and the quotation from my answer to Q. 667, as given in this question I am now answering, would be more explicit, and would convey exactly what I mean, if modified by the statement in my answer to X Q. 713, and this is the qualification with respect to the statement quoted in this question which I now point out, as requested.

718 X Q. It is true that you made a statement in answer 667, as to a particular sense in which you imagined or supposed that Mr. Boyden may have used the word "additional," and your arguments, in that answer, relate to this particular understanding that you seem to have had, as to the "sense" in which Mr. Boyden used the word. But I ask you now to point out, in your answer 667, if you can, where you stated that you could not find the term "additional" used in the specification of patent 360,070, in the particular "sense of separation;" and to point out, if you can, where, in that answer 667, you admit that the term "additional" is used in the specification of patent 360,070.

A. The question is in fact two questions. I will answer the first before the second.

In that part of the answer to Q. 667, commencing with the words "I cannot find the term 'additional,'" and ending with the words "mechanism which performs the fourth function, namely, quick

action," and in the part commencing with the words "in conclusion then, as to the use of the term 'additional,'" continuing on to the words "upon the further traverse of the triple-valve piston," and in the general nature and text of the answer, will be found very clearly expressed, when taken all together, as it should be, my statement that the term "additional" was not used in the specification of patent 360,070 in the particular sense of "separation." A specific case is found in the following quotation from that answer:

"I cannot find that the inventor, in the description and specification of the device of patent 360,070, conveyed, or intended to convey, the sense of integrality or non-integrality, when referring to, and describing, the auxiliary mechanism which performs the fourth function, namely, quick action."

In answer to the second question of the double question I am now answering, I will say that it must be clear that, although the answer to Q. 667 is a long one and covers a good deal of ground, yet there are manifestly many things that are not said, and many statements that are not made, and if there is anything that I have omitted, that the counsel wishes to have me admit or state, I will try to do so, if it accords with the facts. I cannot consent to admit that my answer is wrong when fully considered, and this must be clear from the explanation I made in answer to X Q. 713.

Answer objected to as not responsive to the question.

719 X Q. Your answer 667 is a statement and argument dealing very largely with your views as to the difference between the meaning of the words "additional," "auxiliary," "supplemental" and "separated," and as your argument appears to hang upon the peg that Mr. Boyden used the word "additional" in the sense of "separated," and, in this connection, you made the statement, which I have pointed out several times, to wit, that you could not find the term "additional" in the specification of patent 360,070. I ask you now whether, in view of the explanation that you have given with reference to your inability to find that term in the specification, it would not have been more candid, and have been the whole truth, to have stated, in that connection, that the word "additional" *was* in the specification.

Objected to as cumbering the record, and wasting complainants' time, with useless and improper statements and arguments of defendants' counsel, as to what the witness has said and what he has not said, and what he ought to have said and what he ought not to have said, which are in nowise calculated to enlighten the court upon any questions in this cause. Complainants' counsel submits to the court that, as he now requests defendants' counsel to do, the latter should limit his questions to inquiries as to such matters that he desires to be informed upon, and should refrain from arguments, which may be perfectly proper at the hearing, but which can have no result here beyond that of wasting time.

Counsel for defendants replies that he cannot reasonably be ex-

to in line 46, p. 3, of the specification of the patent 360,070. I have sought to elicit a categorical answer to that question, but thus far you have, in your answers, wandered from the point. I now ask you if you will give me a categorical answer, yes or no?

650 A. Yes, I have just said in the preceding answer that any sort of an "auxiliary slide-valve," whether integral or non-integral, is an "additional member," and is one of the "certain additional members" described in the specification of patent 360,070.

727 X Q. In your examination-in-chief you testified that you *had been led to infer* that Mr. Boyden, when referring to the "triple valve proper" and the "auxiliary valve" of complainants' patent 360,070 as the two valves which perform the quick application of the brakes, used the term "additional" in connection with the auxiliary valve, in the *sense of being separated* from the triple valve. You dissented from this view.

Now I ask you, did not Mr. Boyden have good ground for using the term "additional" in the sense of "separate," in view of the fact that complainants' patent, in the drawings, shows the "auxiliary valve 41" to be entirely separate from the triple valve, and the specification describes it in terms that make it perfectly clear that in its structure it is separate from the triple valve.

Counsel for complainants objects to, protests against, and asks the attention of the court to the waste of time caused by defendants' counsel persistently inserting, in his questions, lengthy arguments in support of his views of the case, instead of limiting his questions, as he should do, to the matters as to which he desires to obtain either statements of mechanical fact or expert opinions from the witness.

Counsel for defendants replies that this witness has, at great length, given his views and opinions as to what Mr. Boyden probably meant, or what he thinks he meant, in using the word "additional" in his testimony, and he has gone to the length of expressing opinions as to what the specification of the patent means,

and what it does not mean, in endeavoring to controvert
651 and deny views which he supposes Mr. Boyden to hold.

As the question now put to the witness is distinctly based upon facts that are pointed out in complainants' patent, it would seem to be entirely proper that the witness' arguments and opinions should be tested by the question now addressed to him.

Counsel for complainants rejoins that the facts just stated by defendants' counsel as to the testimony of this witness, if they be facts, constitute no warrant for the constant interjection of argumentative matter into the questions of defendants' counsel.

A. No.

728 X Q. Will you please indicate, if you can, any portion of the drawing which shows, or the specification of complainants' patent which states, either directly or in substance, that the "auxiliary valve" 41 which performs the function of admitting compressed air directly from the main air pipe to the brake-cylinder, may be integral with the triple valve, or the main valve of the triple valve?

A. Line 51, page 3, of specification, and line 24, p. 4, of specification. As a specification of a construction, I should distinctly understand from this that the essential feature and characteristic of the slide-valve 41 is, that it shall be "auxiliary," and as that term does not refer to anything but the function of the slide-valve, and not at all to its integrality, I should certainly understand that the specification meant that the slide valve 41 might be integral or non-integral so long as its function was an "auxiliary" one.

Answer objected to as irresponsible to the question.

729 X Q. The witness' attention is called to the last question, in which he was distinctly asked to point out where the specification states that the auxiliary valve 41 may be integral with the triple valve. A responsive answer is requested to that question.

Objected to as fully answered, the witness having in reply to X Q. 728, specified lines 51, p. 3, and 24, p. 4, and stated his distinct understanding of such matter in "a specification of a construction."

Counsel for defendants replies that it is submitted to the court that the answer of the witness is not responsive to the question propounded to him, and, if he can indicate in the specification of the patent any place where it is stated that the auxiliary valve may be *integral* with the triple valve, his so doing will be a satisfactory response.

Counsel for complainants invites the attention of the court to the fact that defendants' counsel has now changed the terms of the question as to which he requests a "responsive answer." In X Q. 728 he asks for a reference to a portion of the specification which states "either directly or in substance," and his present inquiry, as supplemented by his reply to complainants' counsel's objection, asks for an indication of a portion of the specification "where it is stated." The question is therefore a new one, and not a repetition of a previous one, to which defendants' counsel alleges he has not received a responsive answer.

Defendants' counsel will change the form of the question, as it appears the witness and counsel for complainants appear to shield the witness from the charge of being irresponsible in his last answer, by reference to the particular form of the question.

Counsel for complainants further asks the attention of the court to the fact that he has not attempted to "shield" the witness, and does not perceive that he needs any shielding, but has merely called the attention of defendants' counsel to the difference, in terms, between the two last preceding questions.

(Question 729 withdrawn.)

730 X Q. Will you please indicate, if you can, any portion of the drawing which shows, or the specification of complainants' patent which states, that the "auxiliary valve" 41, which performs the function of admitting compressed air directly from the main air pipe to the brake-cylinder, may be integral with the triple valve, or the main valve of the triple valve?

A. I have built many mechanisms from specifications; in fact, that has been, at times, my principal occupation, and to me, with that experience, the reference I have made to the specification of patent 360,070, states, in substance, that the slide-valve 41 may be integral with any other part.

731 X Q. While I cannot agree with your ingenious answer, and the very remarkable view you take of the two lines in the specification to which you have referred, I will ask you whether it is not a fact that lines 51, 52 and 53 of p. 3 state, that the auxiliary slide-valve 41 is connected to and moves with the stem 36, and I ask you whether the said stem 36 is not entirely separate from the parts of the triple valve?

A. In the particular construction shown in the drawings of patent 360,070, which is only one of many of the constructions that can be built wholly within the specification of patent 360,070, the "auxiliary" slide-valve 41 moves with the stem 36, and stem 36 is separate from the parts which perform the plain triple-valve functions, but, for all purposes of practical operation, stem 36 might just as well be integral with, and a part of, the triple-valve piston.

The last part of the answer, commencing with the words "but for all purposes," is objected to as merely a volunteered statement, and as showing the anxiety of the witness to lug in, at every opportunity, some reference to "integral."

732 X Q. Could not X Q. 731 have been responsively and truthfully answered in the affirmative?

A. No, not and tell the whole facts; the question did not state that the particular construction shown on the drawings of patent 360,070 was being inquired about.

733 X Q. X Q. 731 related to but a single fact, and that was, whether or not the said stem 36 is entirely separate from the parts of the triple valve. Is not this so?

Objected to as incompetent, as just what the question relates to may be clear in the mind of counsel, but may have a different meaning either to the court or to the witness, and, therefore, instead of asking the witness what the question relates to, counsel should specifically tell him what it relates to, or what he desires it to relate to, and obtain his answer thereon.

Counsel for defendants objects to objections made by counsel for complainants which seem to have for their object instructions to the witness.

Counsel for complainants is entirely satisfied to submit the question of the propriety and competency of his objections to the better judgment of the court.

(In view of the discussion X Q. 733 is withdrawn.)

Adjourned to Wednesday, January 10, 1894, at 10.30 a. m.

655

NEW YORK, January 10, 1894—10.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of D. L. BARNES resumed:

734 X Q. I have just observed that you did not give a responsive answer to X Q. 730. I will, therefore, now repeat that question.

Will you please indicate, if you can, any portion of the drawings which shows, or the specification of complainants' patent which states, that the "auxiliary valve" 41, which performs the function of admitting compressed air directly from the main air pipe to the brake-cylinder, *may be integral with the triple valve, or the main valve of the triple valve?*

A. The fact that the specification does not state that it shall be non-integral, is quite sufficient instruction to me, based on my experience with specifications, that the auxiliary valve may be integral or non-integral, as it is a really unimportant detail of construction. What is important is, that the auxiliary slide-valve shall be actuated by the further traverse of the piston to perform the auxiliary or fourth function, and that important feature is distinctly specified.

735 X Q. Then, I understand that you cannot indicate anything in that patent which shows or states that the auxiliary valve 41 may be integral with the main valve of the triple valve; but you merely infer that the auxiliary valve may be integral, from the fact that the specification does not state that it shall be non-integral. Is that your position?

A. As you have stated in the question, the specification does not say that the auxiliary valve shall be non-integral, thus leaving it entirely to the mechanical common sense of the designer, as to which construction he shall use.

736 X Q. A former question, to wit, X Q. 728, is substantially the same as X Q. 734, the only difference being that the former included the words "either directly or in substance." I observe that you have shifted your position, in giving your answer to X Q. 734, from that which you took in giving your answer to X Q. 728.

In your answer to the former question, 728, you referred to line 51, p. 3, of the specification and line 24, p. 4, of the specification, as indicating to you that the auxiliary valve 41 may be integral. I wish you would explain just how you find, in the matter pointed out at those places in the specification, that the slide-valve may be integral with the main valve of the triple valve, if that is what you mean?

The argumentative matter of the question, being all preceding the words "I wish you would explain," objected to as being irrelevant, immaterial, and a waste of time.

A. My answers to X Q. 728, and X Q. 734 and X Q. 736, I think fully explain what I am now asked about. I will now add, that

the specification leaves entirely to the designer, the unimportant matter of the detail construction of the auxiliary valve, as well as its location. It may be a part of the main valve, or it may not be. To me the specification is clear and distinct in this matter, and I see no contradiction in my answers to X Qs. 734 and 728, and I think it is manifest that there is none. Any designer of mechanism would not hesitate, under the strictest direction of the specification of patent 360,070, to design and locate the auxiliary valve as his best common sense might direct, provided always that it be so arranged so as to perform the auxiliary function upon the further traverse of the piston. These are the only limitations placed upon the designer in that specification.

737 X Q. Then, in response to the question to indicate, from the drawings or specifications of complainants' patent, your warrant for stating that the auxiliary slide-valve may be integral with the main valve of the triple valve, you still refer to the two places in the specification mentioned in your answer to X Q. 728, do you?

A. Yes, sir.

738 X Q. I will quote from the two places, to wit: line 51, p. 3, of the specification of complainants' patent.

"rapidity and full force, and auxiliary slide."

I will also quote line 24, p. 4, of complainants' specification.

"36 and auxiliary slide-valve 41 which instantly."

Do you desire the court to understand that because you have built many mechanisms from specifications, and because of your experience in that line, which you allege to have, you read out of the matter quoted in the two lines just given, a statement which informs you that the slide-valve 41 may be integral with the main valve of the triple valve?

Objected to, as embodying a wholly unwarranted assumption of counsel.

Counsel for defendants protests against the objection of counsel for complainants, because, if the matter stated is unwarranted, the witness is able to see it, and needs not to be instructed in that regard.

Counsel for complainants asks the attention of the court to the waste of time caused by the replies of defendants' counsel, of tenor similar to the last preceding one, it being perfectly obvious that no "instruction" whatever is either afforded or intended by the objection of complainants' counsel.

Counsel for defendants desires to say that he certainly has the right to cross-examine this witness, and to take the necessary time to do so. And further he must be the judge as to how he
658 will conduct the cross-examination, always with due respect to the court.

He also desires to point out the fact that this witness consumed six days in giving his testimony-in-chief, and this is but the second day of his cross-examination.

To which complainants' counsel rejoins, that whether this witness has consumed *six* days or *sixty* days, in giving his testimony-in-chief, the length of that deposition is no warrant for cumbering the record, and consuming complainants' time, with unfounded and useless replies of the character of that last referred to.

A. I have been questioned about the meaning, in substance, of the lines quoted in the question, and asked as to my warrant for my opinion, and this I have given so fully that it is not necessary to repeat it here. It is perfectly clear that the lines quoted from the patent in question make no statement as to integrality or non-integrality, but the matter is left entirely to the good judgment of the designer, it being really an unimportant detail, which any good mechanic might settle, as I have indicated before.

739 X Q. In your answer to X Q. 730 you state, "I have built many mechanisms from specifications; in fact, that has been at times my principal occupation." Do you mean that you have built mechanisms from specifications and drawings furnished by others, who desired you to build in accordance with such specifications and drawings?

A. I do.

740 X Q. Then would you not, in such cases, build the required mechanism in accordance with the drawings and specifications furnished you as your guide?

A. Certainly I should, and I should always give preference to the specification. Generally, the drawings are examples of construction under the specification, of which examples there may be many.

Specifications in general, distinctly state, in terms that cannot be misunderstood, what are the essentials in construction to follow, and, likewise, leave the non-essentials to the good judgment of the constructor. If it is desired that any part be made separate from any other part, it would say so, and if it was immaterial whether they should be separate or not, that would be left to the constructor, in order that he might use his best judgment in construction and save expense and complication.

741 X Q. In your answer to Q. 667 you have stated:

"I cannot find that the inventor, in the description and specification of the device of patent 360,070, conveyed or intended to convey the sense of integrality or non integrality, when referring to and describing the auxiliary mechanism which performs the fourth function, namely, quick action."

In view of this statement, all that you have stated elsewhere in your testimony, relative to your belief or opinion that the auxiliary valve 41 may be integral with the main valve of the triple valve, is based on a knowledge you have at this time, or a belief that you have at this time, that quick-action triple valves of the type of patent 360,070 *can* be so made that the air which is admitted from the train-pipe directly to the brake-cylinder, in quick action, will be controlled by a valve which is integral with the main valve of the triple valve. Am I correct about this?

A. You are not correct. My opinion is based solely on the spec-

ification, and any mechanical engineer accustomed to working from specifications, would, I am confident, understand the specification just as I have explained that I understand it.

742 X Q. Have you not stated, in the matter quoted in the last question, from your answer to Q. 667, that "I cannot find that the inventor * * * conveyed or intended to convey the sense of integrality" * * * and, if this is so, how do you reconcile the statement quoted with other statements to the effect that the slide-valve 41 may be integral with the main valve of the triple valve?

Objected to as not proper cross-examination, first, in presenting to the witness a garbled and incomplete extract from his testimony, and second, because the question institutes a comparison between such garbled statement and other statements of the witness, and then asks a reconciliation of them.

Counsel for defendants replies that what counsel for complainants has termed a "garbled and incomplete extract from the testimony of the witness" is really not garbled at all, but is a fair brief, quoting the exact words of the testimony of the witness.

A. My answer to Q. 667 is not properly quoted in the question. I will now quote it, and show that there is not the slightest need of reconciliation:

"I cannot find that the inventor, in the description and specification of the device of patent 360,070, conveyed or intended to convey the sense of integrality or non-integrality when referring to and describing the auxiliary mechanism which performs the fourth function, namely, quick action."

Evidently, if the inventor, in preparing his specification, did not convey the sense of integrality or non-integrality, certainly then "the slide-valve 41 may be integral with the main valve of the triple valve," or it may be non-integral, as the good sense of the mechanical designer may dictate in such an unimportant detail.

If the inventor had wanted or intended to have confined the essential features and characteristics of construction to integral or non-integral constructions, he would certainly have said so in his specification, just as he has defined such features and characteristics as he has considered essential.

There is nothing mysterious or indefinite about my replies, or about the specification. It is a plain, simple mechanical direction about how to construct the essential features and characteristics of a mechanical device.

743 X Q. I understand that your criticism of my question 742, to wit, that your answer to Q. 667 is not properly quoted, is based on the fact that in my question 742, I briefed the quotation which I had made at length in my question 741.

After all that has been said by you on this point of integrality or non-integrality, I understand you simply to mean that, so far as you are concerned, in your reading of the specification of complainants' patent 360,070, and at the same time, leaving out of consideration altogether the claims of that patent, and leaving out of

consideration altogether any legal restrictions or limitations that may be in the claims of that patent, you consider that the specification would warrant you, as a constructor or builder, in making the auxiliary slide-valve 41 either integral or non-integral, just as you chose. Is this right?

Objected to, so far as assuming that the quotation made in X Q. 741 has been fairly or correctly "briefed" in X Q. 742.

Counsel for defendants desires to say that he is utterly at a loss to understand why counsel should, in view of the great value of time to him as heretofore stated this morning on the record, waste time now by the entry of the objection now in question.

A. Your question is a double one. I will answer it as two questions.

The quotation of my statement, in X Q. 742, is not correct, as it does not quote what I said, and I decline to accept such a quotation as expressing my meaning. The quotation is garbled, because it omits important parts of my expressions, and would convey an improper and unwarranted impression of my meaning.

In regard to the second question of this double question, I will say:

1st. My replies to questions on the subject in point do not relate in any way to how I am "concerned," but solely to the subject-matter of the specification of patent 360,070, in which is expressed, in clear language, sufficient for any designer, what it is that the inventor considers is essential to his construction.

2d. I have not considered the claims of patent 360,070, or the "legal restrictions or limitations" of those claims, as that is wholly a matter of law, in which I am not posted or expert, but always refer such questions to counsel.

3d. I do not consider "that the specification would warrant" me, "as a constructor or builder, in making the auxiliary slide-valve 41 either integral or non-integral" just as good common mechanical sense would dictate.

Adjourned to Thursday, January 11, 1894, at 11 a. m.

NEW YORK, *January 11, 1894*—11 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

The cross-examination of the witness David Leonard Barnes is here suspended, by consent, to admit of the examination of Selwyn J. Kidder and Frederick M. Nellis.

SELWYN J. KIDDER, a witness produced on behalf of complainants, being duly sworn, deposes and says in answer to interrogatories propounded to him by J. Snowden Bell, Esq., of counsel for complainants, as follows, to wit:

663 744 Q. What is your name, age, residence and occupation?

A. Selwyn J. Kidder, residence Chicago, Ill., age 47, occu-

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pation locomotive engineer, and the last nine years, railroad traveling engineer and inspector of the Westinghouse Air Brake Company.

745 Q. Please state the nature and extent of your experience as a locomotive engineer and in connection with air brakes for railroads?

A. I was occupied as a locomotive engineer for about fourteen years, as traveling engineer about three years, and for about sixteen years of that time I was intimately connected with the operation and maintenance of air brakes. During the six years that I have been connected with the Westinghouse Air Brake Company I have made a specialty of air brakes.

746 Q. Are you familiar with the construction and operation of the defendants' quick-action triple valve illustrated in plate XI defendants' 1891 catalogue?

A. I am.

747 Q. Have you ever operated, or seen operated, in practical railroad service, a quick-action triple valve similar to that illustrated in said plate XI?

A. I have.

748 Q. I refer you to the following statement, as to the manner of operating the quick-action triple valve of plate XI, defendants' 1891 catalogue, which I quote from page 28 of said catalogue, to wit:

"To apply the brakes, (*not a quick action*) an amount of air is allowed to escape gradually from the train-pipe that will move the piston 29 to unseat the main valve 22 and allow air to pass from the auxiliary reservoir to the brake-cylinder through the same ports as when graduating, and in addition through that one opened by the main valve 22."

664 As a locomotive engineer, familiar with air-brake practice, please state, with your reasons, whether or not a quick-action triple valve, like that shown in plate XI defendants' 1891 catalogue, can be operated, in practical railroad service, in the manner described in the foregoing quotation?

A. No sir, it cannot. My observations, in noting the performance of this valve referred to, have been that there are but two actions of this valve that can be noted, each movement of which is radical, and results in either a graduated application or in an emergency application.

749 Q. To what peculiarity of structure or operative principle, is due the fact that but two actions of this valve can be noted, resulting, respectively, in a graduated application or in an emergency application, as stated by you in your last preceding answer?

A. In the operation of this triple valve, the graduation takes place resulting from a limited movement of the triple-valve piston, which permits the air to flow from the auxiliary reservoir to the brake-cylinder through the port or passage *i, j, k* in stem 18. If a sufficient reduction of pressure is made in the train-pipe, causing the triple-valve piston to move sufficiently to unseat valve 22, valve 26 is unseated, and air flows directly from the train-pipe to the brake-cylinder, resulting in an emergency application of the brakes.

750 Q. What, if any, practical tests or experiments have been made by you confirmatory of your statement that the quick-action triple valve of plate XI defendants' 1891 catalogue cannot be operated in practical railroad service in the manner specified in the extract from defendants' 1891 catalogue, p. 28, which is quoted in Q. 748?

A. I have experimented with triple valves on moving trains and standing trains, and with a triple valve on a rack, glass discs being inserted in the sides of the triple valve, making it convenient to observe the movement, if any, of the valve 22.

In these experiments in handling trains, I failed to observe any action of the triple valve, other than the two movements before indicated.

665 In testing this triple valve on a rack, I found it impossible, in making various applications, to get any movement of valve 22, unless a quick action took place, excepting when the train-pipe pressure was reduced below an equalizing pressure which took place in the auxiliary reservoir and brake-cylinder.

751 Q. When and where were the experiments in handling trains, to which you refer in your last preceding answer, made by you?

A. They were made during the months of October and November, 1893, on the Jacksonville Southeastern railway, and I had also made some previous experiments on the Atchison, Topeka, & Santa Fé railroad, perhaps two years ago.

752 Q. Were the results of your experiments on the Atchison, Topeka, & Santa Fé railroad similar to, or different from, that of your experiments on the Jacksonville Southeastern railroad?

A. They were somewhat different, though practically the same. On the Atchison, Topeka, & Santa Fé railroad, the experiments were made on a standing passenger train, a gauge being used on the auxiliary reservoir of one car, from which we could note the variations of pressure in the auxiliary reservoir, and the angle cock or stop-cock at the end of the car was used in lieu of an engineers' brake-valve.

753 Q. When did you first hear any mention of such a proposed or supposed operation of the Boyden quick-action triple valve of plate XI defendants' 1891 catalogue, as is stated in the quotation from said catalogue made in Q. 748?

A. I think it was some four to six months ago when my attention was first particularly called to that which has been quoted.

754 Q. And for how long previous to the time that your attention was first called to the statement quoted, had you been familiar with quick-action triple valves similar to that of plate XI defendants' 1891 catalogue, or been in communication with any persons employed in railroad service who were using such quick-action triple valves?

666 A. I have been familiar with the construction, and, to some extent, the operation of the triple valve referred to, for probably three years past.

755 Q. Have you or not ever known such an operation of the Boyden quick-action triple valve, plate XI defendants' 1891 cata-

logue, as is specified in the quotation therefrom made in Q. 748, to be practiced by locomotive engineers in regular railroad service, or heard it referred to by locomotive engineers as a recognized or known mode of operating such quick-action triple valves?

A. I have not.

Cross-examination by CHARLES B. MANN, Esq., of counsel for defendants:

756 X Q. In the experiments made by you with triple valves on moving trains and standing trains, did the Boyden triple valves have glasses inserted in the sides?

A. No, sir.

757 X Q. Then, as I understand you, you did not actually see how the valve 22 moved in those experiments?

A. Not by observation of the valves themselves.

758 X Q. How did you manipulate the engineers' valve in the experiments you made; did you cause it to make intermittent discharges of air from the train-pipe, or a slow and continuous discharge?

A. Both.

759 X Q. In the case where you manipulated the engineers' valve to produce a slow and continuous discharge of air from the train-pipe, are you sure that the valve 22 did not finally unseat, and admit, say from five to ten pounds, of auxiliary reservoir pressure to the brake-cylinder?

A. Well, I feel sure in my own mind that such a result did not take place.

760 X Q. But can you say positively that it did not?

A. I will say positively in my own mind that it did not.

667 Answer objected to as not responsive to the question, and the question is repeated.

761 X Q. Can you say positively, from any knowledge you have, that the valve 22 did not finally unseat, and admit some auxiliary reservoir air to the brake-cylinder?

A. Well, from my knowledge of the action of air brakes operated by a triple valve of this kind, I should feel justified in positively stating that such a result did not take place.

762 X Q. Will you not admit that where you manipulated the engineers' valve to produce a slow and continuous discharge of air from the train-pipe, in the experiments made on the railroads, the valve 22 might not finally have unseated and admitted from five to ten pounds of auxiliary reservoir pressure to the brake-cylinder without your knowing it?

A. I have no hesitation in saying I do not think such a result could have taken place without my noticing it.

763 X Q. If the particular result, which I have named, had taken place, how could you have noticed it in the experiments made on the railroads?

A. In an experiment of the kind, the retarding force imparted to the train would have been noticeable had the valve 22 been opened

and air discharged from the auxiliary reservoir to the brake-cylinder by this method.

764 X Q. Perhaps you do not understand fully the scope of my question, and I will, therefore, restate it in other words.

In the experiments made by you on the railroads, where you manipulated the engineers' valve to produce a slow and continuous discharge of air from the train-pipe, the question is: after the auxiliary reservoir air had passed to the brake-cylinder, sufficient to produce an equalization between the auxiliary reservoir and brake-cylinder, excepting the last five or ten pounds, might not
668 valve 22 have unseated, and admitted the last five or ten pounds to the brake-cylinder, without your knowing it?

A. With the experiments that I have made, which were quite numerous, where the movement of the valve 22 could be plainly seen, in the case of the triple valve having glasses in the sides, it would appear conclusive to me that such a condition could not take place, as, in making those experiments with the valves with glass sides, my opportunities were of the character to demonstrate very much more fully, that this movement of valve 22 could not be accomplished under the case recited in the question.

765 X Q. Do you think that when applying the brakes, under the conditions stated in the last question, when the auxiliary reservoir air had equalized in the brake-cylinder, excepting the last five or ten pounds, that the addition, to the pressure in the brake-cylinder, of the last five or ten pounds, would produce such an additional retarding force to the brakes of the train as would have been especially noticeable, in the stopping of the train?

A. It would.

766 X Q. While that would be true, you think, if the train were running, I now ask, if, in the same experiments made when the train was standing, you had anything to indicate to you positively that the valve 22 did not unseat at the final equalization and admit the last five or ten pounds?

A. Owing to the changed conditions related, I should conduct experiments of that kind on a little different line. While I might, in the event of the moving train, depend upon certain movements of the train from which to draw my deductions, with the standing train, to demonstrate the performance or non-performance of the valve 22, I should rely on other means to determine whether or not any movement of valve 22 took place.

767 X Q. As to the experiments made about which I am inquiring, that is, those which you made on the railroads where the
669 Boyden valves did not have the glass sides, had you any other means to determine positively whether or not valve 22 unseated on the final equalization, to admit the last five or ten pounds of auxiliary reservoir air to the brake-cylinder?

A. Well, as I didn't make any experiments of that kind, I cannot answer the question.

768 X Q. You say that you have been occupied as a locomotive engineer for about fourteen years. Did you ever have charge of a passenger train in regular service?

A. I did have.

769 X Q. Please state when, and for how long a time.

A. I had experience in handling that class of a train, off and on, during most of that time. This was on the Chicago, Burlington and Quincy railroad.

770 X Q. Were you familiar with the air brakes which were used on passenger trains in regular service run by you prior to 1887?

A. I was.

771 X Q. During your experience as an engineer running passenger trains of five to ten cars, did you ever have occasion to apply the brakes in an emergency, to stop the train in the shortest possible distance, that is, prior to the year 1887?

A. I did.

772 X Q. In running passenger trains prior to 1887, in the case of emergency, did you manipulate the engineers' valve to discharge the train-pipe air intermittently, or slowly and continuously, or did you open the engineers' valve to its fullest extent and leave it open to discharge the air quickly from the train-pipe?

Objected to as not cross-examination, the manner of manipulating the engineers' valve prior to 1887, not having been mentioned or referred to, either directly or indirectly, in the examination-in-chief.

Counsel for defendants states that the witness has testified 670 to his own experience as an engineer, and the question is certainly a proper one, as going to show what his experience and knowledge is.

A. I did not use what is termed an engineers' brake-valve, in handling brakes prior to 1887.

773 X Q. Please state what the engineer did use, prior to 1887, to control the action of the air brakes?

A. What was termed a three-way cock.

774 X Q. In running passenger trains prior to 1887, in the case of emergency, did you manipulate the engineers' three-way cock to discharge the train-pipe air intermittently, or slowly and continuously, or did you open the engineers' three-way cock to its fullest extent, and leave it open, to discharge the air quickly from the train-pipe?

Same objection as was entered to X Q. 772, with the substitution of the words "three-way cock" for the word "valve."

Same rejoinder by counsel for defendants.

A. It depended on the nature of the emergency, whether, in an instance as cited, I would discharge the train-pipe air intermittently, or open the three-way cock to its fullest extent. My usual practice, under such conditions, would be to leave it open to discharge, only a sufficient length of time to assure myself that all the brakes were fully applied.

775 X Q. Then do you wish to be understood as saying, that your usual way, in the case of emergency, of stopping a passenger train in the shortest possible distance, with such triple valves as were used prior to 1887, would be to open the engineers' three-way cock,

and leave it open sufficiently long to assure you that all the brakes were fully applied?

Same objection, and further objected to as irrelevant and immaterial.

Same rejoinder by counsel for defendants.

671 A. Yes.

776 X Q. As you say that you have had long experience in running passenger trains prior to 1887, I will ask you if you were familiar with the triple valves that were then used with the air brakes on passenger trains?

A. I was, from the time the automatic brakes were introduced on the Chicago, Burlington & Quincy R. R., about 1881 or 1882.

777 X Q. Can you identify the kind of triple valve that was used on passenger trains with air brakes, on the C. B. & Q. R. R. between the years 1881 or 1882 and 1887, by pointing the same out in the catalogue of the Westinghouse Air Brake Company, and if your knowledge is sufficient to enable you to do so, I will ask you to look at the catalogue of the Westinghouse Air Brake Company of 1886, on page 33, plate B⁹, and say whether or not the illustration of the valve there shown is one that was in use during the time I have stated?

Objected to as not cross-examination, and defendants' counsel is notified that in persisting in interrogating the witness as to matters wholly foreign to his deposition-in-chief, he makes the witness his own, and that action will be taken accordingly.

Counsel for defendants replies that this witness has been offered to testify, because of his alleged experience as an engineer, and defendants certainly have the right to ask any questions that are calculated to test that knowledge and that experience.

To which counsel for complainants rejoins, defendants' counsel undoubtedly has the right to test the competency of the witness to testify as to the matters regarding which he was asked, and as to

672 which he has answered, in his deposition in-chief, but that he has no right to use this witness for a discussion of questions

wholly foreign to the deposition-in-chief, and for the apparent purpose of supporting some theory of the defense wholly foreign to the matters testified to in chief by this witness.

A. The triple valve shown in plate B⁹, Westinghouse catalogue 1886, I identify as one of the kind that was used on the road where I was employed from the time of the adoption of the automatic air brakes up to 1887.

778 X Q. Did the trains which you, as an engineer, ran between 1881 or 1882 and 1887 have air brakes which were operated by triple valves such as that shown in the plate B⁹ of the Westinghouse catalogue?

Same objection.

A. A portion of the time, the trains which I handled were pro-

vided with triple valves substantially the same as that shown in plate B⁹ of the Westinghouse catalogue.

779 X Q. As you have had no difficulty in identifying the triple valve used at the time inquired about, by reference to the illustration in the catalogue, I will ask you to compare the illustration, plate B⁹, with the illustration in patent 220,556, simply for the purpose of informing me whether or not the triple valve illustrated in the patent, is substantially the same as that illustrated in plate B⁹.

Objected to as not cross-examination and as incompetent, the witness not having been shown to be capable of making the comparison called for.

Counsel for complainants now notifies defendants' counsel that he does not propose to allow the this witness to be examined as an expert on the part of defendants, relatively to matters wholly
673 foreign to his deposition-in-chief, and instructs the witness to decline to make the comparison called for.

A. I decline to make the comparison, under the instructions of counsel.

780 X Q. In the triple valves, such as you say you had experience with from 1881 or 1882 to the year 1887, and such as are illustrated in plate B⁹ of the Westinghouse catalogue 1886, which you have identified; when you applied the brakes on passenger trains of five to ten cars, for the purpose of making an emergency stop, would or would not, the piston 5 move its full stroke?

Objected to as not cross-examination, irrelevant and immaterial. Counsel for defendants enters the same rejoinder as last noted.

A. That would depend upon the rapidity with which the air was discharged from the train-pipe, and, as before stated, the nature of the emergency.

781 X Q. Where the nature of the emergency was such that you desired to stop the train in the shortest possible distance, state whether or not then you would manipulate the engineer's three-way cock so as to cause the piston 5 of the triple valve to move its full stroke.

Same objection.

A. If I manipulate the engineer's three-way cock in a manner to assure myself that the brakes were fully applied, triple-valve piston 5 of plate B⁹ Westinghouse catalogue 1886, would move its full stroke.

782 X Q. In applying the brakes equipped with triple valves like plate B⁹ Westinghouse catalogue 1886, to make an emergency stop where it was desired to stop the train in the shortest possible distance, do you know whether the auxiliary reservoir air would
674 be admitted to the brake-cylinder through the graduating valve 7, or by the slide-valve 6, uncovering the port f?

Same objection.

A. That would depend upon the rapidity with which the air was

discharged from the train-pipe, and the length of train upon which the air was being worked continuously.

783 X Q. In applying the brakes of a five or ten car train, as you have no doubt often done, where the cars were equipped with triple valves like plate B⁹ Westinghouse catalogue 1886, to make an emergency stop, where it was desired to stop the train in the shortest possible distance, do you know whether the auxiliary reservoir air would be admitted to the brake-cylinder through the graduating valve 7, or by the slide-valve 6, uncovering the port *f*?

Same objection, and counsel for complainants, repeating the notice to defendants' counsel given after X Q. 779, instructs the witness to decline to answer this question, or any further questions relating to plate B⁹ of the Westinghouse catalogue of 1886, which was not referred to, directly or indirectly, in the examination-in-chief.

A. I decline to answer this question, under instruction of counsel.

Counsel for defendants states that, as the witness evidently evaded answering responsively X Q. 782, which is exactly the same question as X Q. 783, with the exception that the question last named inquires about a train of five or ten cars; and as the witness answered that question without instructions from complainants' counsel to decline to answer it, this line of cross-examination will not be continued.

675 784 X Q. Are you now in the employ of the Westinghouse Air Brake Company, and if you are, please state how long you have been in that employ?

A. I am, and have been for about six years.

SELWYN J. KIDDER.

FREDERICK M. NELLIS, a witness produced on behalf of complainants, being duly sworn, deposes and says in answer to interrogatories propounded to him by J. Snowden Bell, Esq., of counsel for complainants, as follows, to wit:

785 Q. What is your name, age, residence and occupation?

A. Frederick M. Nellis, age 32, Dennison, Ohio, occupation, locomotive engineer. At present, I am employed as instructor of the Westinghouse Air Brake Company's instruction car.

786 Q. How long have you been in the service of the Westinghouse Air Brake Company?

A. About five years.

787 Q. Please state the nature and extent of your experience as a locomotive engineer and in connection with air brakes for railroads?

A. I first served a regular three-years apprenticeship at the machinists' trade, at the Pittsburgh, Cincinnati and St. Louis Railway shops, Dennison, Ohio, after which I fired three years on that road, ran a locomotive for two years on the same road, was traveling engineer for the Pittsburgh locomotive works for two years, and, for the past five years, have been engaged by the Westinghouse Air

Brake Company, all of which time I have had more or less to do with air brakes.

788 Q. Are you familiar with the construction and operation of the defendants' quick-action triple valve illustrated in plate XI, defendants' 1891 catalogue?

A. I am.

676 789 Q. Have you ever operated, or seen operated, in practical railroad service, a quick-action triple valve similar to that illustrated in said plate XI?

A. I have.

790 Q. I refer you to the following statement, as to the manner of operating the quick-action triple valve of plate XI, defendants' 1891 catalogue, which I quote from page 28 of said catalogue, to wit:

"TO APPLY THE BRAKES FULLY, (*not a quick action*) an amount of air is allowed to escape gradually from the train-pipe that will move the piston 29 to unseat the main valve 22 and allow air to pass from the auxiliary reservoir to the brake-cylinder through the same ports as when graduating, and in addition through that one opened by the main valve 22."

As a locomotive engineer, familiar with air-brake practice, please state, with your reasons, whether or not a quick-action triple valve like that shown in plate XI, defendants' 1891 catalogue, can be operated, in practical railroad service, in the manner described in the foregoing quotation?

A. In my opinion, it cannot. I have tried, in practical service, and also on a rack, to obtain this alleged application, but in both instances have failed to get it.

791 Q. As a result of your trials, both in practical service and on a rack, please state what applications, and *only* what applications, of the brakes can be made, in practical railroad service, by defendants' quick-action triple valve, defendants' plate XI, 1891 catalogue?

A. Only two applications. The ordinary service or graduating application, and the quick-action application.

792 Q. To what peculiarity of structure, or operative principle, of defendants' quick-action triple valve, plate XI defendants' 1891 catalogue, is the fact due that only two applications of the brakes can be made by said valve in practical railroad service, to wit:

677 the ordinary service or graduating application and the quick-action application, as you have stated is the case in your last preceding answer?

A. The valve is so constructed that a gradual reduction of pressure in the train-pipe will allow the main piston to move, and permit pressure from the auxiliary reservoir to pass through port *i, j, k*, in the stem 18, to the brake-cylinder. A quick-action application of the brakes is had by reducing the train-pipe pressure suddenly, and permitting the main piston to travel its full stroke, which opens up valves 26 and 22, allowing train-pipe pressure to flow to the brake-cylinder, the auxiliary reservoir pressure also going to the brake-cylinder

793 Q. Under such construction, what is the result, in practical railroad service, of lifting the valve 22 from its seat?

A. The lifting of valve 22 from its seat, will allow train-pipe pressure to flow into the brake-cylinder, unless a full service application has been had.

794 Q. If a full service application has been had, what, if any, useful result is obtained, in then, or thereafter, lifting or unseating valve 22?

A. There is no practical or useful result obtained, because the pressures have already become equalized.

795 Q. What practical tests or experiments were made by you, confirmatory of your statement that the quick-action triple valve of plate XI defendants' 1891 catalogue cannot be operated in practical railroad service in the manner specified in the extract from defendants' 1891 catalogue, page 28, which is quoted in Q. 790, and that only two applications, to wit, the ordinary service or graduating and the quick-action, can be made in practical railroad service by said quick-action triple valve?

A. I have made two series of tests, one on moving trains, and another on a rack. The experiments on moving trains were made on the Jacksonville Southeastern railroad, on October 26th and November 22d, 1893.

In the first test of moving trains there were three cars, one 678 equipped with the Boyden quick-action triple valve, and two with the Westinghouse plain triple valves. The second test made on moving trains, was made with three cars, all equipped with the Boyden quick-action triple valve.

I made several applications of the brakes, with a view of satisfying myself whether this alleged application referred to could be had, but in every instance, failed to get it. I worked the engineer's brake-valve so as to discharge the air in the manner stated in the catalogue, and made every effort to get this alleged application, but failed to do so. Each application resulted either in a distinct service application or a quick-action application. It is plain to me that this alleged application referred to cannot be had, as my experiments have satisfied me on that point.

The experiments made on the rack with the quick-action valve referred to, were made with the equalizing brake-valve and the ordinary stop-cock, and with a Boyden quick-action triple valve, like that shown in plate XI of defendants' 1891 catalogue, having glass sides, which showed the movement of valve 22. In all experiments made, a service application, obtained as before described, or a quick-action application, followed.

I made special effort to obtain this alleged application, but failed in every instance to get it.

Adjourned to Friday, January 12, 1894, at 10.30 a. m.

NEW YORK, *January 12, 1894—10.30 a. m.*

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of F. M. NELLIS resumed:

796 Q. When did you first hear any mention of such a pro-
posed, or supposed, operation of the Boyden quick-action
triple valve of plate XI defendants' 1891 catalogue, as is
679 stated in the quotation from said catalogue made in Q. 790?

A. About three months ago.

797 Q. And for how long previously had you been familiar with
quick-action triple valves similar to that of plate XI defendants'
1891 catalogue, or been in communication with any persons em-
ployed in railroad service who were using such quick-action triple
valves?

A. For about three years I have been intimate with the working
of said triple valve, so far as could be gained from the catalogue
mentioned, but the information I have had of the operation of this
triple valve in service, has been from men operating it in service,
and has been during the last three months. I have frequently
heard of the operation of this kind of triple valve, but have never
heard of this alleged operation referred to in the extract from the
catalogue.

798 Q. Have you, or not, ever known such an operation of the
Boyden quick-action triple valve, plate XI defendants' 1891 cata-
logue, as is specified in the quotation therefrom made in Q. 790, to
be practiced by locomotive engineers in practical railroad service?

A. I have not, and believe that, if said operation was known and
performed, I would surely have heard of it, having been so inti-
mately associated with these men handling air brakes in practical
railway service.

Cross-examination by CHARLES B. MANN, Esq., of counsel
for defendants:

799 X Q. In answer to Q. 792 you state that

"A quick-action application of the brakes is had by reducing the
train-pipe pressure suddenly and permitting the main piston to
travel its full stroke, which opens up valves 26 and 22, allow-
680 ing train-pipe pressure to flow to the brake-cylinder, the
auxiliary reservoir pressure also going to the brake-
cylinder."

When a quick application of the brakes is had, does the auxiliary
reservoir pressure in going to the brake-cylinder, as you state, pass
through the port opened by the valve 22?

Objected to as irrelevant and immaterial.

A. In a quick-action application of the brakes the pressure from
the auxiliary reservoir going to the brake-cylinder, passes through
port opened by valve 22.

800 X Q. Then your answer is, yes, is it not?

A. It is.

801 X Q. You have testified in answer to Q. 795, that you made two tests on moving trains on the Jacksonville Southeastern railroad, to try the Boyden quick-action triple valve, and that, in every instance, you failed to get the result you were looking for, namely, the lifting of valve 22 from its seat, when trying to apply the brakes fully with auxiliary reservoir air.

How do you know, *for a certainty*, that, in these two tests, the valve 22 did not lift from its seat and admit some auxiliary reservoir air to the brake-cylinder?

A. I do not know for a certainty that there was no auxiliary reservoir air admitted to the brake-cylinder, in making these applications of the brakes, but the results had from these applications were like those had from a plain service application, or a quick-action application of the brakes. If any pressure from the auxiliary reservoir did pass to the brake-cylinder, from the lifting of the valve 22, it was of little consequence, and had no material effect upon the brakes.

802 X Q. As an instructor of air brake operations, I want to ask you consider yourself thoroughly acquainted with all the various operations of the different parts of the air brakes, and whether

81 you consider yourself skilled in the handling of air brakes in practical service?

A. I do consider myself a competent instructor, believing that I have a thorough practical knowledge of the air brake and its operations. I also believe I am a skillful handler of air brakes on trains.

803 X Q. As an instructor of air-brake operations in the employ of the Westinghouse Air Brake Company, are you familiar with the operations of the quick-action triple valve now used, and the plain triple valve which is still used?

A. I am.

804 X Q. Please look at the Westinghouse catalogue, 1890, plate D¹, entitled "The Westinghouse quick-action automatic brake," and at the triple valve illustrated under the head of "tender," and state whether or not the triple valve referred to, is a plain triple valve, such as referred to in my last preceding question?

A. The triple valve referred to is such as I know by the name of plain triple."

805 X Q. I will also ask you to look at the same catalogue (1890), on page 32, and state whether or not plate D²⁰ illustrates the same kind of triple valve last referred to, namely, that which is now used on tenders?

A. This is also a "plain" triple valve, such as is now used on tenders and locomotives.

806 X Q. I will also ask you to please look at Westinghouse catalogue 1886, page 33, plate B⁹, and state whether or not it shows a plain triple valve, such as last inquired about and now used on tenders?

A. This is also a "plain" triple valve, such as is used on locomotives and tenders, and similar to those previously referred to.

807 X Q. I will ask you about the action of the plain triple valve. Suppose an engine and tender, equipped with plain triple valves like plate B⁹ Westinghouse catalogue 1886, and plate D²⁰ catalogue 1890, and suppose such an engine and tender were connected 682 to a train of fifty cars, equipped with quick-action triple valves, and an emergency application of the brakes was made, would not the pistons of the plain triple valves on the locomotive and tender, move their full stroke, and thereby admit auxiliary reservoir air to the brake-cylinder, through the port uncovered by the slide-valve?

Objected to as irrelevant and immaterial, and as not proper cross-examination, not having reference to any matters referred to in the examination-in-chief.

A. If the train were so equipped, and an application made as you describe, the triple-valve pistons of the tender and locomotive would travel their full stroke, and permit auxiliary reservoir pressure to pass to the brake-cylinder through ports uncovered by the slide-valves.

808 X Q. Suppose the same conditions of locomotive, tender, and train, equipped with plain triple valves and quick-action triple valves, as stated in the last question, to exist, and it was desired to apply the brakes for a service stop, would not the pistons of the plain triple valves on the locomotive and tender make only a partial stroke, and thereby admit auxiliary reservoir air to the brake-cylinder by the graduating valve, which, in plate B⁹ Westinghouse catalogue 1886, is designated 7?

Same objection.

A. If on a locomotive and tender equipped with plain triple valves, and a fifty-car train equipped with quick-action triple valves, it was desired to have a service application of the brakes, a gradual reduction of pressure in the train-pipe would cause the pistons of the plain triple valves on the locomotive and tender to travel part of their stroke, and permit pressure from the auxiliary reservoir to flow through graduating port 1 to the brake-cylinder.

683 809 X Q. Then I understand that your answer is yes; am I right?

A. You are right.

810 X Q. Then I understand by your testimony that the Westinghouse plain triple valve has two valves, to admit auxiliary reservoir air to the brake-cylinder, one of which is opened by the preliminary traverse of the piston, while the other is opened by the complete traverse of the piston; is this right?

Same objection, and counsel for complainants, repeating the notice to defendants' counsel given after X Q. 779, instructs the witness to decline to answer this question, or any further questions relating to the plain triple valves of the Westinghouse Air Brake Company's

catalogues, which were not referred to, directly or indirectly, in his examination-in-chief.

A. I decline to answer the question, under instructions of counsel.

Counsel for defendants protests against and objects to the instruction of complainants' counsel to the witness, that he shall decline to answer :

First, because counsel for defendants has the right to test the knowledge and competency of the witness, who has testified as an expert fully acquainted with the practical operations of triple valves for air brakes.

Second, because the question which the witness has been instructed not to answer, and other questions to follow, would, if answered truthfully, be instructive to the court, and would tend to show that the defendants are not trespassers and infringers on the rights of complainants.

684 Third, because the said instruction, although apparently based on the ground that the question is not a proper one on cross-examination, will, in reality, have the effect to prevent a disclosure of the knowledge this witness possesses as to the real action of triple valves, and will thus suppress the whole truth.

To which counsel for complainants rejoins :

First. That while it is true that the witness has testified as an expert " fully acquainted with the practical operations of triple valves for air brakes," he has been examined, and has testified, only as to the operation of the defendants' quick-action triple valve, and has given no testimony whatever, in chief, relatively to the plain triple valves of the Westinghouse Air Brake Company's catalogues. If counsel for defendants desires, as he alleges, " to test the knowledge and competency of the witness," he has an ample opportunity to do so by inquiries as to the operation of the mechanisms, or other mechanisms, of the class as to which he has testified.

Second. That the witness has not been examined in chief, and is not here, " to show that the defendants are not trespassers and infringers on the rights of complainants," and that whatever evidence defendants desired to offer in that regard should have been offered in their own testimony ; they have no right to seek to use complainants' witness as an expert on their behalf, by inquiries irrelevant to the testimony-in-chief.

Third. That " the whole truth " as to the matters testified to by the witness in chief may be obtained, in the event of its not having been already stated, by interrogatories, on the part of defendants' counsel, relevant to such matters as were testified to in chief.

685 Counsel for defendants states that, as the witness has declined, under instructions from complainants' counsel, to answer the last question, the cross-examination will not be continued.

F. M. NELLIS.

Cross-examination of DAVID LEONARD BARNES resumed:

811 X Q. You have stated that the function of a valve is the purpose or office. Does not valve 22, of defendants' quick-action triple valves, serve the purpose or office of admitting auxiliary reservoir air to the brake-cylinder, at the same time that it is admitting train-pipe air to the brake-cylinder, in producing a quick-action application of the brakes?

A. Valve 22 does not control the admission of air from the auxiliary reservoir to the brake-cylinder when a quick-action application is made. The control is wholly by the restricted passage B, which corresponds to the restricted passage 35 of complainants' valve.

The answer is objected to as not responsive to the question and as being evasive of the question.

312 X Q. You were not asked, in the last question, whether the "*valve 22 does not control the admission of air.*" X Q. 811 repeated.

A. The function inquired about is that of admitting auxiliary reservoir pressure to the brake-cylinder. This function is regulated, in a service application, by the ports *i, k, j*, and in a quick-action application, by the port B. If the valve 22 did not lift from its seat, this function would be performed and regulated by the ports *i, k, j*. The opening of the valve 22 gives a larger passage from the chamber C to the brake cylinder, but it can admit no more air from the auxiliary reservoir than will pass through the passage B, although the passage opened by valve 22 is enormously larger than
686 passage B, hence the control of the admission, which is the equivalent to the regulation of the admission, and is the function, and the necessary function, to be performed, with respect to the auxiliary reservoir pressure, at the time of quick action, is all performed by passage B. Any other passage leading from the cavity C to the brake-cylinder would answer just as well as the passage opened by valve 22, and its size would be immaterial, so long as it is larger than B.

Valve 22, like many parts of compound mechanisms, has a principal function for which it is designed, also several minor functions which it performs incidentally; the minor functions, therefore, are incidental functions, which are allotted to the different parts as a matter of convenience, or for some other practical purpose.

The case of valve 22 is about like this: It has a principal function of admitting the air from the train-pipe to the brake cylinder, at the time of quick action, and it has the incidental function of opening a larger passage from the cavity C to the brake-cylinder, thus rendering the cavity C, practically a part of the brake-cylinder, thus permitting the auxiliary reservoir pressure to flow more freely from the restricting and controlling point B to the brake-cylinder, and to this extent, and to this extent only, has valve 22 any function whatsoever, with respect to the auxiliary reservoir pressure. On the other hand, the function of admitting auxiliary reservoir pressure to the brake-cylinder, at the time of quick action, and the complete and full control of this function, is performed by the passage B; there-

fore, it is clear that the function of admitting the auxiliary reservoir pressure to the brake-cylinder, at the time of quick action, is performed by the passage B, that being the only function of passage B, hence such function cannot be performed by valve 22. It would be misleading to say that valve 22 serves "the purpose or office of admitting auxiliary reservoir air to the brake-cylinder at the same time that it is admitting train-pipe air to the brake-cylinder, in producing a quick application of the brakes," and yet, when valve 22 is opened, the air from the auxiliary reservoir passes through the passage opened by valve 22, but it is not in any way controlled by that passage, but is wholly controlled by the restricted passage B.

Counsel for defendants objects to the answer because it is evasive, not responsive and, at the outset, misstates the inquiry to which the question relates. The answer is apparently an endeavor on the part of the witness to muddle the subject inquired about, instead of making it clear.

813 X Q. The question is now repeated, as follows:

Does not valve 22, of defendants' quick-action triple valves, serve the purpose or office of *admitting auxiliary reservoir air to the brake-cylinder, at the same time that it is admitting train-pipe air to the brake-cylinder, in producing a quick-action application of the brakes.*

Will you be kind enough to answer this question, omitting the irrelevant matters?

A. If the "office" or "purpose" of a part is the "function" which it controls, then I answer, no; but if the "office" or "purpose" is assumed to be a function which it does not control, then, to that extent, and that extent only, do I answer, yes.

If I am confined to a categorical answer, then I say, no, with the distinct understanding that my answer is to be taken together with the explanation I have given in this and the last preceding answer.

Counsel for defendants objects to the answer as an apparent endeavor to evade.

814 X Q. I will vary the question a little, and put it again, as follows:

When a quick application of the brakes is had, does the auxiliary reservoir pressure, in going to the brake-cylinder, pass through the port opened by the valve 22?

688 A. Yes.

815 X Q. When a quick application of the brakes is had with the valve shown in the drawings of complainants' patent, does the auxiliary reservoir pressure, in going to the brake-cylinder, pass through the port opened by the auxiliary valve 41?

A. No.

816 X Q. Are not two valves employed in the quick-action valve shown in the drawings of complainants' patent 360,070, to produce a quick action of the brakes—one of which is the auxiliary valve 41 to admit the train-pipe air to the brake-cylinder, and the other is

one of the triple valves to admit auxiliary reservoir air to the brake-cylinder?

A. I ask for further light on this question. In what sense is the term "triple valves" used in the question, and is the question confined strictly to the single illustration of one of the many constructions possible under the specification of patent 360,070?

Counsel for defendants states that it would seem that no further light on the question were needed, inasmuch as the term "triple valves" clearly has reference to a triple valve that will functionate, as stated in the question, "*to admit auxiliary reservoir air to the brake-cylinder.*" The question also states that the inquiry is "*confined*" to the quick-action triple valve shown in the drawings of complainants' patent 360,070.

817 X Q. I will now repeat the question :

Are not two valves employed in the quick-action valve shown in the drawings of complainants' patent 360,070, to produce a quick action of the brakes—one of which is the auxiliary valve 41 to admit the train-pipe air to the brake-cylinder, and the other is one of the triple valves to admit auxiliary reservoir air to the brake-cylinder?

689 Will you please answer the question, in view of the "further light" stated in the explanation made by me?

A. "To produce a quick action of the brakes" of the device shown in the *drawings*, a further traverse of the piston is employed. To permit quick action to take place, there is an auxiliary valve and a restricted passage, just as in defendants' valves. As I have said before, it is indefinite to refer to the names of parts, unless such names define definitely the function of the parts. For all intents and purposes of practical operation, a restricted passage becomes a valve when it controls the admission of a fluid, and passage B of defendants' device is an example of this.

Two valves may be combined in one part or piece and yet be two valves, or they may be separate in structure and still be two valves.

No; quick action is *produced* by the further traverse of the piston.

Counsel for defendants objects to the answer, as an apparent endeavor to evade the real question, and as not being a response to the question.

818 X Q. As a mechanical engineer, do you make the remarkable statement that a restricted passage, or any passage, which is always open and in condition to pass fluid, is a valve?

A. Yes, when it performs the functions of a valve. Valves are used not alone to stop the flow of fluids, but to restrict their flow, and, when a valve is so used, it is the equivalent of a restricted passage.

The witness has begged the question entirely, as the statements in the last answer contain qualifications not stated in the question nor stated in his previous answers.

690 Counsel for complainants desires that it be noted that the foregoing remarks were made by defendants' counsel.

819 X Q. As you are the only person whom I have ever known to designate the passage B of defendants' quick-action triple valve as "*a valve*", and as none of the witnesses in this case have heretofore termed it a valve, or as having the function of a valve, and as you have not heretofore so called it, or referred to it as having the functions of a valve, but do so now for the first time, I ask you what is your warrant for now calling it a valve?

Objected to, because embodying the erroneous assumption that the witness has designated, termed, or called, the passage B "*a valve*."

Counsel for defendants replies that complainants' counsel, in his effort to help the witness, has overlooked this statement in the answer of the witness to X Q. 817.

"For all intents and purposes of practical operation, a restricted passage becomes a valve when it controls the admission of a fluid, and passage B of defendants' device is an example of this."

Counsel for complainants, while here, as heretofore, of the opinion that argument on the record is unprofitable, deems it proper to rejoin that he has not as yet perceived that the witness has stood in need of help from him or from any one else, and has made no effort whatever in that direction. He has by no means overlooked the quotation from answer 817, made in the reply of defendants' counsel, and also has fully in mind the witness' answer to X Q. 818, and, in view of those answers, considers that the statements of the witness, as to the equivalency, under certain conditions, of a restricted passage and a valve, are no warrant whatever for the allegation of defendants' counsel that the witness has *designated, termed or called* a restricted passage a "*valve*."

A. As I have explained in answer to X Q. 818, one of the functions, and in fact, one of the principal functions of a valve, is to restrict the flow of fluids, and I now refer counsel to complainants' Record, page 560, folios 2239 and 2240, wherein is described the function of a restricted passage like passage B, having the function of restricting the flow of fluids, and to page 571, folio 2282, where I have referred to the passage B as having the function of passage 35, complainants' device; likewise to page 577, folio 2207, and to other parts of my testimony. It is clear, then, that the question is in error in stating that I have not before said that passage B has the function of restricting the flow of fluid, which I now say, as I did in answer to X Q. 818, is one of the principal functions of a valve.

I have not said that the passage B is a valve, but only that, in restricting the flow of fluids, for all intents and purposes of practical operation, it becomes a valve.

Especially is this true in the case of passage B, which is made of a specific area, with reference to the passage uncovered by the opening of valve 22, which specific area performs no useful purpose, except to act as a valve to restrict the flow of auxiliary reservoir pressure, when the valve 22 is opened for the performance of quick action, and this only upon the further traverse of the piston.

820 X Q. Do you desire the court to understand that the passage

B of plate XI, defendants' 1891 catalogue, as used in the structure there shown, is a valve?

A. Only in the sense that it has the function of a valve that I have defined, namely, the function of restricting the flow of fluids.

821 X Q. Has not the nozzle of a hose pipe a restricted passage?

A. Yes.

692 822 X Q. Does not the restricted passage of the nozzle of a hose pipe perform a useful function?

A. Yes.

823 X Q. Because the nozzle of a hose pipe has a restricted passage which performs a useful function, does it therefore functionate as a valve?

A. Only in that it has one of the functions performed by valves, namely, that of restricting the flow of a fluid.

Take the case in point, a hose attached to a street-main hydrant. If the valve in the hydrant is opened wide, the flow is restricted by the nozzle of the hose; if the valve in the hydrant is partly opened, the flow is restricted by the valve; thus they do have the same and identical function of the restriction of a fluid.

824 X Q. If the nozzle of a hose pipe has the function of a valve, as you say, why, then, do they not use a valve on the end of a hose pipe instead of the nozzle?

Objected to as irrelevant and immaterial, which objection is continued, without further notice, as to the entire line of examination on the subject of hose pipes.

A. They did; I have used them so myself.

825 X Q. I call your attention to port 35, in the slide-valve shown in the drawing of complainants' patent 360,070, and ask you if it is not opened and closed by the movement of the said slide-valve, and does it not, by reason of such opening and closing, functionate as a valve?

A. No; as the function of a valve, with respect to opening and closing something, is this:

A valve opens and closes a port, or permits a port to perform its function, and I cannot see how port 35 can open itself.

Port 35 manifestly and clearly has but the single function as a port or passage, and as a restricted port or passage, to admit
693 air from the auxiliary reservoir to the brake-cylinder, just as is done by port B, and in the same sequence, with respect to other operations of a quick-action triple valve, and upon the further traverse of the piston.

826 X Q. Then I understand you to say, in response to the first part of my question, which asks you if port 35 "is not opened and closed by the movement of the said slide-valve," that your answer is, "no." Is this the way you desire your answer to stand?

A. Port 35 is for the purpose of admitting auxiliary reservoir air to the brake cylinder, and is *always open to the auxiliary reservoir air*. It is the port 23 that is open and closed, by the movement of the main valve 14, between the auxiliary reservoir and the brake-cylinder. Passage 35 is permitted to perform its useful function, upon

the further traverse of the piston, in complainants' device, just as passage B is permitted to perform its useful function, in defendants' device, upon the further traverse of the piston.

827 X Q. You say true enough, that port 35 is *always open to the auxiliary reservoir air*, but is it not true, that port 35 is opened and closed to permit the passage of auxiliary reservoir air, and to prevent the passage of that air, in just the same measure as port 23, which you have referred to?

A. Port 35 is *always open* to auxiliary reservoir air, and in this way distinctly differs from port 23, which is not.

Auxiliary reservoir air is permitted to pass through the port 35, upon the opening of passage 23 by the valve 14, upon the further traverse of the triple-valve piston. In order that the resemblance between the port 35 and the port B may not be misunderstood from my testimony, I will now compare them as to details.

First. Ports 35 and B are always open to auxiliary reservoir air.

Second. Ports 35 and B have the same specific area, with reference to the large ports opened by the auxiliary valves 41 and 22, for the same specific purpose of restricting the auxiliary reservoir pressure; the specific dimensions being about one-eighth of an inch in diameter for ports 35 and B, and about one inch in diameter for ports uncovered by valves 41 and 22. The areas of these diameters represent the comparative areas of the respective openings approximately.

Third. During the performance of the three triple-valve functions prior to 1887, ports 35 and B are absolutely inert and have no useful purpose. The port 35 might be removed, and the port B destroyed, by the removal of the ring 9 of defendants' device, without interfering with, or destroying, either of the three functions of the triple valves prior to 1887.

Fourth. Ports 35 and B are brought into useful and practical operation, only upon the further traverse of the piston.

Fifth. Ports 35 and B have the single function, and the single and only useful purpose, of restricting the flow of auxiliary reservoir air to the brake-cylinder, at the time of quick action.

Sixth. The single difference between the ports 35 and B lies in the location, with respect to other parts. This incidental arrangement of passage B so locates it that the auxiliary reservoir air passes through it, but is in no way controlled or effected by it, during the performance of the three triple-valve functions prior to 1887.

No; port 35 is always open to the auxiliary reservoir air, and for the passage of that air upon the further traverse of the piston, when port 23 is opened to the brake-cylinder.

Counsel for defendants objects to the answer, as being a long volunteered statement, concerning matters not inquired about in the question. The question calls for no consideration at all, of the passage B in defendants' triple-valve device.

Counsel further objects to the conduct of the witness in appar-

695 ently endeavoring to evade a square answer to the question propounded to him. Objection is further made that the answer is not responsive.

828 X Q. X Q. 827 is repeated.

A. I replied "no," in my last answer, and I again make the same reply, for the reasons given.

829 X Q. The witness is requested to indicate where the answer "no," which he professes is a responsive answer to the question occurs in his answer.

A. At the beginning of the last paragraph.

830 X Q. I now repeat X Q. 827.

"You say true enough, that port 35 is *always open to the auxiliary reservoir air*, but is it not true, that port 35 is opened and closed to permit the passage of auxiliary reservoir air and to prevent the passage of that air in just the same measure as port 23, which you have referred to?"

And I will now also quote the "no," where it occurs in the last paragraph, and will also quote the paragraph:

"No; port 35 is always open to the auxiliary reservoir air, and for the passage of that air upon the further traverse of the piston when port 23 is opened to the brake-cylinder."

I now ask you if you desire the court to understand that the answer quoted is a full and fair response to the question.

Objected to by reason of the misstatement that "the answer" has been quoted, the fact being, that, as the record will show, only the last paragraph of the answer has been quoted.

A. Yes; and I will further add an example to further illustrate the truth of my answer.

696 Let there be a reservoir, and a passage leading from it; the passage is always open, then there will always be more or less of the fluid or pressure that is in the reservoir, in the passage. If the passage is opened and closed, then, sometimes there will be reservoir fluid or pressure in the passage, and at other times there will not be. Manifestly, the passage 35 is always open, there is always reservoir fluid and pressure in that passage.

Adjourned to Saturday, January 13, 1894, at 10 a. m.

NEW YORK, *January 13, 1894*—10 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of D. L. BARNES resumed:

Counsel for defendants objects to all that part of the last answer after the first word "yes," as not being responsive to the question and as showing a disposition on the part of the witness to lug in irrelevant matter.

831 X Q. Is it not true, respecting both port 35 and port 23, that it is the movement of the slide-valve 14 which permits either

these ports to pass the auxiliary reservoir air to the brake-cylinder, when making a quick-action application of the brakes?

A. I do not understand the question.

832 X Q. Please state wherein you do not understand the question; it seems to be a plain one for a mechanical engineer, skilled, as you say you are.

A. A port permits the air to pass, but I do not understand how a port can pass the air. It is the pressure of the air itself that passes it. If the counsel wishes to know if the movement of the
697 slide-valve permits air to pass through the port 35 and port 23, then I answer, yes.

It may make my meaning clearer to counsel, regarding this question of the always-open nature of port 35, if I show an example in the case of the slide-valve 14, where there is a port through that valve that is not always open. Port 31 is such a port. It, like port 35, performs the second function of plain triple valves prior to 1887, but differing from port 35, it is not always open, as it is opened and closed by valve 29.

The active principle which passes the air, is not the inert port, but the air pressure.

833 X Q. It seems to me that your attempt to draw a distinction, or to discriminate respecting the capability of the *ports to pass the air, and the movement of the slide-valve permitting air to pass the ports*, is a mere play upon words.

I will now call your attention to your statement made in your examination-in-chief, in Complainants' Record, p. 593, under folio 2372, as follows:

"(c) The only function of port 35, its office and purpose, is the second function of triple valves prior to 1887, namely, that of admitting air from the auxiliary reservoir to the brake-cylinder. It has no other function, and can have no other, as is manifest from its construction, and its location in relation to other parts."

Is not this a correct quotation from your testimony, and have you not here stated, in substance, that the port 35 is a valve having the function of triple valves, namely, to admit air from the auxiliary reservoir to the brake-cylinder?

Objected to as irrelevant, immaterial and uselessly consuming time, the first paragraph being merely a criticism of the testimony of the witness, and so much as constitutes a question
398 relating to a fact which will be self-evident from an inspection of the record.

Counsel for defendants replies that the question now put to the witness is relevant and is material, because it will afford him an opportunity to explain what appears to be an inconsistency between the testimony given on page 593 in his examination-in-chief, and that which he has given in his last few answers in his cross-examination.

A. The quotation is correct.

I have not said that port 35 is a valve.

834 X Q. Have you not said that the "function of a valve is its purpose or office"?

A. I have.

835 X Q. Did you not state, in the matter quoted in my X Q. 833; "the only function of port 35, its office and purpose, is the second function of triple valves prior to 1887"?

Counsel for complainants strenuously objects to this utterly useless repetition of verbatim quotations from the testimony of the witness, as shown by the record, with questions to him as to whether or not he stated what the record *shows* he stated.

Counsel for defendants replies that it is his privilege and duty to criticise the testimony of the witness given in his examination-in-chief, and if he sees what appears to him to be inconsistencies of statement, to call the attention of the witness to the same, in order that he may have an opportunity to explain the same, if he can. Counsel for defendants, therefore, insists that this line of examination is *not* "utterly useless."

To which counsel for complainants rejoins that he has made no objection whatever to the "line of examination," but to the
699 utterly useless questions to the witness, as to whether or not he stated what the record *shows* that he stated. Defendants' counsel can call the attention of the witness to any statements that he made, and have him compare them, or reconcile them, if counsel supposes them to be contradictory, but it is simply idle, and a waste of time, to ask him whether he *did* so state.

A. Yes.

836 X Q. In view now of your admitted statements quoted in X Q.'s 833, 834, and 835, how do you wish to be understood respecting the port 35? Has it the function of a triple valve, and yet do you deny that it is a valve, in the sense of performing the *purpose* and *office* of a valve?

A. I wish to be understood as follows:

Port 35 is not a valve.

Port 35 has not the functions of a triple valve, as a triple valve is a compound mechanism.

Port 35 has one of the functions of a valve, namely, to restrict the flow of fluid pressure, but this does not make it a valve.

An illustration is found in the case of a broom and a shovel. Both may have the office of cleaning a street, but having the same function, does not make a broom a shovel.

837 X Q. I am at a loss to understand your conflicting statements. In your last answer you say that "*port 35 has not the functions of a triple valve,*" while in your statement made on p. 593, quoted in my X Q. 833, you say *the only function of port 35 is the second function of triple valves.* I confess I cannot understand these conflicting statements. Perhaps you can explain them. If you can, please do so.

Objected to as assuming that there was any conflict between the statements of the witness quoted.

700 A. The function of a triple valve, *per se*, is to apply and release the brakes. The function of port 35 is the second function of triple valves, namely, to admit air from the auxiliary reservoir to the brake-cylinder.

Counsel for defendants objects to the answer, as in no way explaining the apparent conflict between the two particular matters stated in the last X Q.

Counsel for complainants suggests that defendants' counsel must not be surprised if the witness fails to accord with the ideas that defendants' counsel may have, as to suppose conflict between matters stated in the witness' answers.

838 X Q. When making a quick-action application of the brakes, of the device shown in the drawings of complainants' patent 360,070, are not two valves brought into action to perform their functions, to wit, one, which is the auxiliary valve 41, which opens to admit the train-pipe air to the brake-cylinder, and the other, the slide-valve and port 35, which opens to admit auxiliary reservoir air to the brake-cylinder?

A. In the particular example of the construction, under the specification of patent 360,070, that is shown in the drawings of patent 360,070, the auxiliary valve 41, is, as I have repeatedly said before, non-integral with the main valve 14, and in that particular construction, the valve 14 opens port 33 to the brake-cylinder from the auxiliary reservoir, but port 35, as I have said before, is always open to auxiliary reservoir air. Hence, in the particular construction shown in the drawings of patent 360,070, there are two separate valves used to perform the fourth function, but under the specification of patent 360,070, the two valves might as well be integral in one structure.

839 X Q. Then, in your last answer, leaving out of present
701 consideration your views respecting the *non-integral* or *integral* possible plan of construction, and leaving out of consideration, also, your views as to what *might* be done under the specification of patent 360,070, I understand that your last answer admits that it is a fact that, in complainants' patent 360,070, two valves are brought into action, and each performs its function, to wit, one, which is the auxiliary valve 41, which opens to admit the train-pipe air to the brake-cylinder, and the other, which opens to admit auxiliary reservoir air to the brake-cylinder. Is this admission in your last answer?

A. No, I said nothing of the sort. My remarks were entirely confined to the specific and particular construction given in the drawings of patent 360,070, and further, my remarks, in explanation of my last answer, are necessary to the understanding of that answer, and I cannot accept that they be separated from that answer.

840 X Q. When making a quick-action application of the brakes, of the device shown and described in complainants' patent 360,070, I ask you, do you deny that two valves are brought into action to perform their functions, to wit, one, which is the auxiliary valve 41, which opens to admit train-pipe air to the brake-cylinder, and the

other, a valve which opens to admit auxiliary reservoir air to the brake-cylinder?

A. Yes, so far as described in the specification; as the specification does not say that the auxiliary valve shall not be a part of the main valve. So far as the particular construction shown in the drawings is concerned, I answer, no.

841 X Q. Can you point out, in the specification of complainants' patent 360,070, any statement to the effect that, when making a quick-action application of the brakes, one valve may be employed to admit both the train-pipe air to the brake-cylinder, and also the auxiliary reservoir air to the brake-cylinder, by uncovering a port?

702 Objected to, as already, in substance, asked and answered. Counsel for defendants suggests that the objection by complainants' counsel is a groundless objection, even if it has been already asked and answered, which counsel for defendants denies.

A. The specification does not *state* that the auxiliary valve shall be integral, or that it shall not be integral, but the specification contains sufficient directions to enable any practical mechanic to make a quick-action triple valve, and the minor details of location and integrality are left, as they always are in general specifications, to the good judgment of the designer.

842 X Q. Your answer to my last question does not respond by pointing out, in the specification of complainants' patent 360,070, any statement to the effect that, when making a quick-action application of the brakes, one valve may be employed to admit both the train-pipe air and also the auxiliary reservoir air to the brake-cylinder, by uncovering a port.

You merely admit that the specification does not state that the auxiliary valve shall be integral or that it shall not be integral, as to which no question was propounded to you whatever. I now repeat X Q. 841, to wit:

"Can you point out in the specification of complainants' patent 360,070 any statement to the effect that when making a quick-action application of the brakes one valve may be employed to admit both the train-pipe air to the brake-cylinder, and also the auxiliary reservoir air to the brake-cylinder by uncovering a port?"

Same objection.

A. Looking at the specification as a direction how to construct a quick-action triple valve, in the light of my long and continued experience with specifications since 1878, I will say that, to me, the specification of patent 360,070 distinctly permits that "one
703 valve *may be* employed to admit both the train-pipe air to the brake-cylinder and also the auxiliary reservoir air to the brake-cylinder."

So far as any "statement" is concerned, I have distinctly answered the question in my preceding answer, and I now repeat that:

"The specification does not say that the auxiliary valve shall not

a part of the main valve," neither does it state it shall be a part of the main valve.

843 X Q. Then I understand that your answer, in part, is that, in the light of your long experience, to you the specification of complainants' patent "*permits*" that "one valve may be employed to admit both train-pipe air to the brake-cylinder and also the auxiliary reservoir air to the brake-cylinder." But you cannot point out in the specification any specific statement to that effect? Am I correct?

A. Yes.

844 X Q. In defendants' quick-action valve, plate XI, catalogue 01, are two valves employed to produce a quick-action application of the brakes—one which opens to admit only train-pipe air to the brake-cylinder, and another which opens to admit only auxiliary reservoir air to the brake-cylinder?

A. Taking the question in a strict literal sense, I answer, no; but, I have explained in a preceding answer, passage B has the office of a valve, in restricting the flow and regulating the flow of reservoir air, and, therefore, in a practical sense, there are two valves.

845 X Q. In defendants' quick-action valve, when producing a quick-action application of the brakes, are there two ports, each of which is opened by a separate valve, one to admit auxiliary reservoir air to the brake cylinder, and the other to admit train-pipe air to the brake cylinder?

A. Taking the question in a strict literal sense, I answer no; but, I have explained in a preceding answer, two distinct and entirely separate ports are brought into action at the time of quick action, one of which is used "to admit auxiliary reservoir air to the brake-cylinder and the other to admit train-pipe air to the brake cylinder."

846 X Q. In defendants' quick-action valve, when producing a quick-action application of the brakes, is there a port which is uncovered by a valve to admit the passage of train-pipe air to the brake-cylinder, and another port which is also uncovered by a valve, to admit auxiliary reservoir air to the brake-cylinder?

A. Taking the question in a strict literal sense, I answer, no; but, I have explained in a preceding answer, two distinct and entirely separate ports are brought into action, and ports that are used at no other time, for any practical purpose, but have their office solely in assisting to produce quick action. One of these ports is used "to admit the passage of train-pipe air to the brake-cylinder" and the other is used "to admit auxiliary reservoir air to the brake-cylinder." •

847 X Q. Please designate the two distinct and separate ports to which you refer in your last answer.

A. The port uncovered by valve 22 for the admission of train-pipe air to the brake-cylinder, the office of which I have set forth in my preceding answer more fully than here, showing that it corresponds to the port 42 of complainants' device.

The port B for the admission and control of auxiliary reservoir air to the brake-cylinder, the office of which I have set forth in a

preceding answer more fully than here, showing that it corresponds to port 35 of complainants' device.

848 X Q. I understand you to say that the port which admits train-pipe air to the brake-cylinder is uncovered by the valve 22 in the quick-action application of the brakes; now I ask you what valve, if any, uncovers the "port B," which admits auxiliary reservoir air to the brake-cylinder in the quick-action application of the brakes?

A. Port B, like port 35, of complainants' device, is always uncovered to auxiliary reservoir air.

705 The answer is objected to, because it is not responsive. The question does not call for a comparison of "port B" with any other part in complainants' patent.

849 X Q. I will put the question in a slightly different form.

In defendants' quick-action valve, is "port B" uncovered by a valve to put it in condition to admit the passage of auxiliary reservoir air to the brake-cylinder, in the quick-action application of the brakes?

A. There is a wide difference between uncovering a port, and simply putting it into condition to be useful; therefore, I will divide my answer into two parts, one with reference to the uncovering, in a strict literal sense, and the other with reference to putting it into condition to be useful, and I will illustrate my answer with suitable examples to make my meaning clear.

Port B is not uncovered by a valve, but, as I have explained before, is always uncovered to auxiliary reservoir air. An example of this is found, in complainants' device, in port 35, which is not uncovered by a valve, but which is always uncovered to auxiliary reservoir air. A further explanation of this will be found in my preceding answers.

Port B is put into condition to admit and control the passage of auxiliary reservoir air to the brake-cylinder, in a quick-action application of the brakes, by the further traverse of the triple-valve piston. An example of this is found in complainants' device, in port 35.

Counsel for defendants objects to all of the answer, except at the beginning of the second paragraph, where the answer states:

"Port B is not uncovered by a valve," for the reason that it is a volunteered argument, not responsive to the question.

706 850 X Q. I understand that, in defendants' quick-action valve, when making a quick-action application of the brakes, no valve is employed to put port B in condition for admitting the passage of auxiliary reservoir air to the brake-cylinder; while in complainants' quick-action valve patent 360,070, when making a quick-action application of the brakes, a valve is employed to put a port in condition for admitting the passage of auxiliary reservoir air to the brake-cylinder. I now ask you, whether or not you agree with my understanding, as I have just stated it.

Objected to as irrelevant and immaterial.

A. I do not.

851 X Q. Please state whether or not, in both the defendants' quick-action valve and in the quick-action valve of complainants' patent, when making a quick-action application of the brakes, a check-valve which, in defendants' is denoted by 26, and, in complainants' patent, is denoted by 49, does not open to admit the passage of train-pipe air to the brake-cylinder?

A. The check-valves mentioned in the question are opened by the train-pipe air itself, but the office and function of the check-valves is to prevent the return of train-pipe air after it has passed to the brake-cylinder. The valves which perform the function of *opening to admit* train-pipe air to the brake-cylinder are the valve 22 of defendants' device, and valve 41 of complainants' device.

852 X Q. Will you please designate both in defendants' and complainants' quick-action valve devices, those valves which admit the auxiliary reservoir air to the brake-cylinder, when producing a quick-action application of the brakes?

A. The function of admitting and controlling the flow of auxiliary reservoir air to the brake-cylinder in quick action is, as I have before explained in detail, fully performed and regulated by the passage

707 B of defendants' valve, and the passage 35 of complainants' valve; and these ports, in restricting and regulating the flow of auxiliary reservoir air, have, for all practical purposes of useful operation in defendants' and complainants' valves, the function of valves. The difference is this, that port B is fixed, in the structure, in defendants' device, while the port 35 is in the movable slide-valve 14, of complainants' device. Where the auxiliary air goes to, or the passage which it traverses, after passing through the ports 35 and B, is immaterial, provided there is no further regulation, control, or a restriction of it, until it reaches the brake-cylinder. The practical purposes of control are performed by the ports 35 and B.

It is my opinion, that in referring to the parts which admit auxiliary reservoir air to the brake-cylinder, the ports 35 and B should be considered as having the functions of valves, in that they regulate the flow of the fluid, and, to this extent, they may be rightly considered as valves, but only in the sense, as I have just said, that they restrict and control the flow of the fluid. I think the question cannot be answered definitely.

Adjourned to Monday, January 15, 1894, at 10.30 a. m.

NEW YORK, January 15, 1894—10.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of D. L. BARNES resumed:

853 X Q. You say, as the closing part of your last answer:

"I think the question cannot be answered definitely."

Now I ask you to state why you think so?

708 A. Mainly, for the reason that the question adheres to the names of parts, rather than the function of parts, which, as I

have said before, leads to indefiniteness. If the question had been, What parts have the function of admitting "auxiliary reservoir air to the brake-cylinder when producing a quick-action application of the brakes"? then I could have made a definite answer, and would have replied, that the function is performed and absolutely controlled by the passage B of defendants' valve, and the passage 35 of complainants' valve.

To further illustrate the impossibility of a definite answer, I will explain how a passage may be a valve, for all practical purposes of controlling the admission of a fluid, and yet not be correctly termed, a "valve," in the strictest sense, although I think the broad meaning of the term "valve," may, in some cases, be taken rightly to include ports or passages that act as valves.

Passages and ports may be used as ducts, simply for the purpose of conveying a fluid. In such cases, the size of the passage is immaterial, provided it is large enough, but where passages have the function of a valve, in controlling, regulating, and restricting the flow of a fluid, they are made of a definite size, and cannot be larger or smaller, without interfering with the regulation of the function. A case of this kind is found in passage 35 of complainants' valve and B of defendants' valve. These passages are determined by experiment, as to size, and cannot be larger or smaller, without interfering seriously with the quick action of the brakes. The Master Car Builders' Association have proposed requirements which necessitate a very close regulation of the size of the restricted passage leading from the auxiliary reservoir to the brake-cylinder, at the time of quick action, such as passages 35 and B. This emphasizes the fact that these passages control, regulate, and restrict the passage of the fluid, and to that extent, they have the function of valves.

709 Examples of the class of passages that have no necessarily specific size, provided they are large enough, and which simply act as ducts to convey fluid, are the passage 43 of complainants' valve, and the passage uncovered by the valve 22 of defendants' valve.

The question asks, in effect, which valves admit the auxiliary reservoir air to the brake-cylinder when producing quick action. When a valve opens a passage to admit a fluid from a reservoir into said passage, and thence through to a cylinder, it is clear that the passage was previously not opened. This is the case, for instance, with passage 31, when opened by valve 29, but, in the case of passages 35 and B, they were previously open to the fluid from the reservoir, and, strictly speaking, and holding closely to the question—they are not opened by valves, but are brought into action to perform their function, upon the further traverse of the triple-valve piston.

I can give a definite answer to the question if the functions of the parts are asked about.

I quote from the Century Dictionary, regarding a valve :

"Any device or appliance used to control the flow of a liquid, vapor, or gas, or loose material in bulk, through a pipe, passageway, outlet, or inlet, in any form of containing vessel."

In forming my opinion of the broadest acceptable use of the term "valve," I have not been confined to dictionary definitions, but have taken into account the use to which the term is put in practical mechanics.

854 X Q. Is it not a fact that, in complainants' quick-action valve device, the "*part*" which puts the auxiliary reservoir air in communication with the brake-cylinder, when producing a quick-action application of the brakes, is a *part which is opened and closed* by the movement of the slide-valve 14?

A. Port 23 is such a part. It is opened and closed by the valve 14, and puts the auxiliary reservoir into communication with the brake-cylinder, but port 23 does not control the admission
710 of air from the auxiliary reservoir to the brake-cylinder during quick action, but acts only as a duct. The control is wholly with the passage 35, corresponding to passage B of defendants' device, as I have before explained.

855 X Q. In defendants' quick-action valve device, please state what "*part*" is opened and closed by the movement of a valve to put the auxiliary reservoir air into communication with the brake-cylinder, when producing a quick-action application of the brakes?

A. First, is opened the passage *i, j, k*, by the movement of the valve 18, to admit auxiliary reservoir air to the brake-cylinder; then follows the opening of the large passage, by the lifting of the valve 22, upon the further traverse of the piston for the admission of train-pipe air to the brake-cylinder, and this passage being enormously larger than the passage *i, j, k*, the air from the auxiliary reservoir follows the line of least resistance, and nearly, if not quite all of it, will then pass through the passage uncovered by valve 22, and only a smaller portion will go through the passage *i, j, k*. The control of the admission of auxiliary reservoir air to the brake-cylinder, during the quick action, is not provided for by the passage *i, j, k*, nor by valve 22, but solely, as I have before explained, by passage B, which is made of a specific size for that purpose.

As I have before explained, it is my opinion that cavity C should be considered as a part of the brake-cylinder cavity, after valve 22 has been lifted from its seat, and the point of admission, control, and regulation and restriction, of auxiliary reservoir air to the brake-cylinder, is the passage B.

856 X Q. In the device of complainants' patent, does not the slide-valve 14, in putting the auxiliary reservoir into communication with the brake-cylinder, when producing a quick-action application of the brakes, perform a triple-valve function?

A. It performs the second function of plain triple valves prior to 1887, in the manner specified in my testimony before this, and to which I now refer.

857 X Q. I am not quite sure whether your answer is responsive to the question which asks whether, *when producing a quick-action application of the brakes*, the slide-valve 14 performs a triple-valve function? Does it perform this function or not?

Objected to as already fully answered.

A. When producing a quick-action application of the brakes, the valve 14 performs the second function of plain triple valves prior to 1887, in the manner specified in my testimony before this, and to which I now refer. However, it must be remembered that I have distinctly testified that the control of this second function, during quick action, is wholly performed by the passage 35.

Counsel for defendants objects to the last part of the answer, commencing with the word "however," as referring to matters not at all called for by the question, and is therefore not responsive.

858 X Q. With the port *i* (40) plugged, how many valves would take part in the performance of the quick-action function in defendants' triple-valve apparatus; I mean, how many valves would take part in the admission of air pressure into the brake-cylinder, exclusive of the valve which closes the exhaust from the brake-cylinder to the atmosphere?

A. This question relates to a hypothetical valve, and further, any answer that I can make to it will necessarily be indefinite, and have no practical meaning, for the reason that, as I have said before, in compound valves, the number of parts is no indication of the number of functions, or the method of performing the number of functions. In making my answer I shall construe the term "valve" broadly, as the question is of itself a broad one, and demands a general answer. I could give a specific answer, if the parts which perform useful functions, during "the performance of the
712 quick-action function in defendants' triple-valve apparatus, were inquired about.

Leaving out of consideration the port *i* (40) and the valve 17, the remaining valves are check-valve 26, opened by train-pipe pressure, valve 22 for the admission of train-pipe air, opened by the further traverse of piston, and the specific passage valve B.

The answer then is, with the limitation given in the question: three valves.

859 X Q. In defendants' quick-action valve, when making a service application of the brakes, will the auxiliary reservoir air pass through the passage B to the brake-cylinder?

A. Yes, but it is not controlled by that passage, as I have explained in my preceding testimony. It was shown by the experiments that I have cited, that, for all the purposes of service application, the passage B might be destroyed by the removal of the ring 9, and the same practical and useful results be obtained.

Counsel for defendants objects to the entire answer, except the first word "yes," as a volunteered statement not called for by the question.

860 X Q. In complainants' quick-action valve, patent 360,070, when making a service application of the brakes, will the auxiliary reservoir air pass through the port 35 to the brake-cylinder?

A. No. I have so testified in a preceding answer.

861 X Q. In defendants' quick-action valve, as exemplified both in the 1889 and 1891 catalogues, when the piston makes its full

stroke, does it not use a valve which opens a port, through which port both train-pipe air and auxiliary reservoir air pass to the brake cylinder?

A. In defendants' quick-action valves, when the piston completes its stroke, the piston opens a port, by lifting valve 22 for the admission of train-pipe air, and, incidentally, the auxiliary reservoir
713 air passes through that port to the brake-cylinder, but it is not in any way controlled by that port, and that port might as well be removed, so far as it is of any practical value in regulating the admission of auxiliary reservoir air. A specific case of this kind is found in defendants' valve, 1889 catalogue, where the port uncovered by the valve 18 has more than sufficient capacity to permit the passage of all of the auxiliary reservoir air that can flow through the port *e*, thus showing, that the port uncovered by valve 22 performs no useful function, with respect to the auxiliary reservoir pressure, but incidentally becomes a duct, through which the auxiliary reservoir air passes to the brake-cylinder. In fact, for all intents and purposes, as I have before explained, the cavity C is practically a part of the brake-cylinder cavity.

As defendants' quick-action valves do not make any practical use, with respect to auxiliary reservoir air, of a valve that is opened by the complete stroke of the triple-valve piston, as I have explained, and bearing that explanation in mind, I answer that:

Defendants' quick-action valves do not use a valve which is operated by the further traverse of the piston, to open a port through which the auxiliary reservoir air passes to the brake-cylinder during quick action, but there is such a valve operated in said manner, which is used for a definite practical purpose, to admit train-pipe air to the brake-cylinder, and which train-pipe air is not admitted or controlled in any other way.

862 X Q. In complainants' patent 360,070, when the piston makes a preliminary traverse, is it not the valve 29 which functionates to admit air from the auxiliary reservoir to the brake-cylinder?

A. Yes, after valve 14 has been moved.

863 X Q. Does not Defendants' Exhibit Illustrative Cuts Drawing No. 3, and the red line thereon, correctly show the course of the auxiliary reservoir air as it passes to the brake-cylinder, when the piston makes a preliminary traverse?

714 A. Yes.

864 X Q. In complainants' patent 360,070, when the piston makes a preliminary traverse, does any valve or valve mechanism at that time functionate to admit air directly from the main air pipe to the brake-cylinder?

A. I am asked about the "patent 360,070," but I wish to say here that my answers are entirely confined, both in this case and in any preceding, to the specification and drawings of that patent.

No.

865 X Q. In the quick-action triple valve of complainants' patent 360,070 when the piston makes a preliminary traverse, does any valve, or valve mechanism, at that time functionate to admit air directly from the main air pipe to the brake-cylinder?

A. No; air is admitted from the main air pipe to the brake-cylinder upon the further traverse of the piston, not during the preliminary traverse.

866 X Q. In the quick-action triple valve of complainants' patent 360,070, when the piston "is forced to the extreme limit of its stroke," or, in other words, when the piston makes a complete traverse, to effect the admission of air *directly from the main air pipe to the brake-cylinder*, is it the valve 29 which then functionates to *admit air from the auxiliary reservoir to the brake-cylinder*?

A. Under the specification, valve 29 might perform the function of admitting air from the auxiliary reservoir to the brake-cylinder during quick action, as I have explained in my answer to Q. 690, wherein, and in previous answers, I have described a construction shown by the exhibit "Complainants' Exhibit Westinghouse Modification." In the particular construction shown on the drawings of patent 360,070, which is one of the designs that may be constructed from the specification of that patent, valve 29 does not perform the function of admitting auxiliary reservoir air to the brake-cylinder during quick action.

867 X Q. In the quick-action triple valve of complainants' patent 360,070, when the piston "is forced to the extreme limit of its stroke," or makes a complete traverse to effect the admission of air *directly from the main air pipe to the brake-cylinder*. I ask you what valve, or valve mechanism, at that time functionates to *admit air from the auxiliary reservoir to the brake-cylinder*.

A. As I have distinguished between the different quick-action triple valves that may be constructed under the specification of patent 360,070, it is necessary now for me to inquire to which construction this question refers?

868 X Q. The question of course refers to the quick-action triple valve of that construction shown in the drawings of complainants' patent 360,070. Please answer the question with this understanding?

A. In the particular construction shown in the drawings of patent 360,070, the port 35 controls the admission of air from the auxiliary reservoir to the brake-cylinder during quick action, as I have set forth in detail in a preceding answer.

In so far as port 35 may be considered to be a valve, as I have explained before, it is the valve mechanism which admits the air from the auxiliary reservoir to the brake-cylinder during quick action. Incidentally, the slide-valve 14 is moved, but the control of the admission of air from the auxiliary reservoir to the brake-cylinder at that time, is wholly performed by the port 35.

869 X Q. Does not the Defendants' Exhibit Illustrative Cuts *Drawing No. 7*, and the red and blue lines thereon, correctly show, in the quick-action triple valve of complainants' patent 360,070, the course of the two kinds of air, namely, the auxiliary reservoir air and the train-pipe air, in passing to the brake-cylinder during quick action?

A. With the understanding that the question refers to the specific construction shown in the drawings of patent 360,070, I answer, yes.

870 X Q. Has the quick-action valve shown in the drawings of

716 Complainants' Patent 360,070, a passage leading from the auxiliary reservoir to the piston chamber, and another passage leading from the piston chamber to the valve chamber—the latter passage being smaller in area than the former?

A. I ask for information as to which chambers are referred to.

The names of the chambers are not a sufficiently definite description of the location for me to make an intelligent reply.

871 X Q. I will state the question again.

Has the quick-action valve shown in the drawings of complainants' patent 360,070, a passage leading from the auxiliary reservoir to the chamber containing the piston 12, and another passage leading from the said piston chamber 12 to the valve chamber 24—the latter passage being smaller in area than the former?

A. Yes. Auxiliary reservoir air reaches the piston chamber through the passage shown at the left of Fig. 2 of the drawings of patent 360,070, and this is a larger passage than the passage 51, which leads from the piston chamber to the valve chamber 24. These are the differential passages which enable the establishment of differential pressures to operate the triple-valve piston.

872 X Q. Is not the passage 51 to which you refer in your last answer, the feeding-in or charging passage for train-pipe air, when going to the auxiliary reservoir?

A. It is.

873 X Q. Has the quick-action valve shown in the drawings of complainants' patent 360,070, a passage leading from the auxiliary reservoir to the chamber containing piston 12, and another passage, also for auxiliary reservoir air, leading from the piston chamber to the valve chamber—the latter passage being smaller in area than the former?

A. Yes, the same passages that I have described in the preceding answer, that is, so far as I understand the question.

717 If the functions of the passage are described, I can make a more intelligent answer.

874 X Q. In complainants' quick-action valve, of patent 360,070, does the piston perform the function of admitting auxiliary reservoir air and train-pipe air to the brake-cylinder, or do valves which are actuated by the piston perform those functions?

A. As to which is the performing part of the quick-action triple valve, would depend largely upon how one looks at it. The primary actuating part, and I might say the primary "performing" part, is the triple-valve piston.

875 X Q. Is this the best answer you can make to my last question?

A. It is the most concise, and I can explain, in detail, the action and office of all the individual parts of the quick-action triple valve shown in the drawings of patent 360,070, but I have done this before.

It is pretty clear that the performance of all the functions is inaugurated by the movement of the triple-valve piston.

At 4 p. m., at request of defendants' counsel, adjourned to Tuesday, January 16, 1894, at 10.30 a. m.

NEW YORK, *January 16, 1894*—10.30 a. m.

Met pursuant to adjournment.

Present: Counsel as before.

Deposition of D. L. BARNES resumed:

876 X Q. Has the quick-action valve, shown in the drawings of complainants' patent 360,070, a partition between the valve chamber 24 and the chamber containing the piston 12, which partition divides said two chambers in such manner that a higher
718 pressure of auxiliary reservoir air may be produced on one side of the piston than will exist in the valve chamber when the piston has made its full stroke towards the train-pipe?

A. No.

877 X Q. Can any part of the valve structure shown in the drawings of complainants' patent 360,070, be removed, so as, by such removal, to cause the auxiliary valve 41 to functionate as a triple valve by passing auxiliary reservoir air to the brake-cylinder?

A. No, not so far as I can see from the construction shown in the drawings.

878 X Q. Please state whether or not defendants' quick-action valve has a passage from the train-pipe, a passage from the auxiliary reservoir which is smaller or more restricted than said train-pipe passage, and a single valve coacting with both of said passages and controlling communication between them and the brake-cylinder, whereby, when an emergency application of the brakes is desired, the train-pipe air and auxiliary reservoir air, the former at lower pressure than the latter, will both pass to the brake-cylinder through the single valve?

A. No, for the reasons that I have set forth in detail in preceding answers, where I have shown that passage B controls communication between the auxiliary reservoir and the brake-cylinder, at the time of quick action, and for other reasons that I have given in detail.

879 X Q. Please state whether or not the quick-action valve of complainants' patent 360,070 has the two passages and a single valve coacting with both of said passages, all as stated in the last question?

A. The question, as well as the preceding question, relates to the "control" of the air from the auxiliary reservoir, and it is with that in mind that I made the preceding answer, and now answer to this question, no.

880 X Q. Please state whether or not the quick-action valve
719 of complainants' patent 360,070 has a piston actuated in one direction by auxiliary reservoir pressure, and in the opposite direction by train-pipe pressure, and a single slide-valve, controlling the passage of air to the brake-cylinder from both the train-pipe and the auxiliary reservoir for an emergency application of the brakes?

A. Yes; under the specification of the patent, such construction is allowable. The question is not confined to the drawings. An example of such construction I have described in preceding answers

and have shown how such construction is left, by the specification of patent 360,070, together with other non essential details, to the judgment of the designer; such modification of construction not being an essential or characteristic feature of the specification.

881 X Q. Please designate the preceding answers wherein you have described such a construction as that stated in the last question.

A. Answers to Qs. 667, folios 2230 to 2234, 2240 to 2243, 2244 to 2253; 668, folios 2268 and 2269; 670, folio 2284; 672, folios 2280, 2290, 2297, 2298, 2299, 2315, 2316, 2319, 2320, 2323, 2324; 673, folio 2407; 678, folio 2448; 693, folio 2488; 702, folio 2526; 703, folio 2528; 710, folio 2553; 711, folio 2556; 712, folio 2558; 713, folio 2560; 714, folio 2564, and in answers to other questions.

882 X Q. In your answer to X Q. 880 you say :

"Yes; under the specification of the patent, such construction is allowable."

Please to point out where, in the specification of patent 360,070, you find your warrant for that statement?

Objected to as already fully answered.

Counsel for defendants has no knowledge of an answer to this question.

A. In my answers to X Qs. 737, 738, for the reasons given in answers to X Qs. 728, 734 and 736.

883 X Q. You have explained, with reference to Mr. Boyden's testimony, your criticism of Mr. Boyden's improper use of the word "additional," notwithstanding the fact that the word "additional" is in the specification.

Do you wish to be understood as making the same explanation with reference to Mr. Church's use of the word "additional," in view of your statement on page 558, folio 2230 (C. R.) where you said :

"I cannot find the term additional used in the specification and description of the patent 360,070."

A. Yes; and this answer must be taken in connection with my answer to X Q. 713, which further explains my answer to Q. 667, which is quoted or referred to in this present question.

884 X Q. Have you ever conducted any tests under your own direction, on railroad trains in practical service, with quick-action triple valves of the form shown in complainants' letters patent 360,070?

A. No.

885 X Q. The court is to understand that all of your testimony has been given, and all the opinions you have expressed, have been without any consideration on your part of the claims of patent 360,070. This is so, is it not?

A. Yes.

886 X Q. The court is also to understand that in giving your testimony and expressing your opinions about patent 360,070 or about defendants' quick-action triple valves, you have not considered any restrictions and limitations that may be in the claims of said patent. This is so, is it not?

A. Yes.

DAVID L. BARNES.

Adjourned *sine die*.

GEORGE WESTINGHOUSE, JR., of Pittsburg, Pennsylvania.

Fluid-pressure Automatic-brake Mechanism.

Specification forming part of Letters Patent No. 360,070, dated March 29, 1887.

Application filed November 19, 1886. Serial No. 219,353. (Model.)

To all whom it may concern :

Be it known that I, George Westinghouse, Jr., residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, a citizen of the United States, have invented or discovered certain new and useful improvements in fluid-pressure automatic-brake mechanism, of which improvements the following is a specification :

The object of my invention is to enable the application of brake-shoes to car-wheels by fluid pressure to be effected with greater rapidity and effectiveness than heretofore, more particularly in trains of considerable length, as well as to economize compressed air in the operation of braking by utilizing in the brake-cylinders the greater portion of the volume of air which in former practice was directly discharged into the atmosphere.

To this end my invention, generally stated, consists in a novel combination of a brake-pipe, an auxiliary reservoir, a brake-cylinder, and a "triple-valve" device governing, primarily, communication between the auxiliary reservoir and the brake cylinder, and, secondarily, communication directly from the brake-pipe to the brake-cylinder.

The improvements claimed are hereinafter fully set forth.

In the application of the Westinghouse automatic brake as heretofore and at present commonly in use, each car is provided with a main air-pipe, an auxiliary reservoir, a brake-cylinder, and a triple valve, the triple valve having three connections—to wit, one to the main air-brake pipe, one to the auxiliary reservoir, and one to the brake-cylinder. The main air-pipe has a stop-cock at or near each of its ends, to be opened or closed as required, and is fitted with flexible connections and couplings for connecting the pipes from car to car of a train, so as to form a continuous line for the transmission of compressed air from a main reservoir supplied by an air-pump on the engine. When the brakes are off or released, but in readiness for action upon the wheels of the train, the air which fills the main reservoir and main air-pipes has a pressure of from sixty-five to seventy-five pounds to the square inch, and by reason of the connections referred to the same pressure is exerted in the casings of the triple valves on both sides of their pistons and in the auxiliary reservoirs connected therewith. At the same time passages called "release-ports" are open from the brake-cylinders to the atmosphere. When it is desired to apply the brakes, air is allowed to escape from

(Model.)

3 Sheets—Sheet 1

G. WESTINGHOUSE, Jr.

FLUID PRESSURE AUTOMATIC BRAKE MECHANISM.

No. 360,070.

Patented Mar. 29, 1887.

Nos 403 & 426
Westinghouse }
-v- 272
Boydell Co }

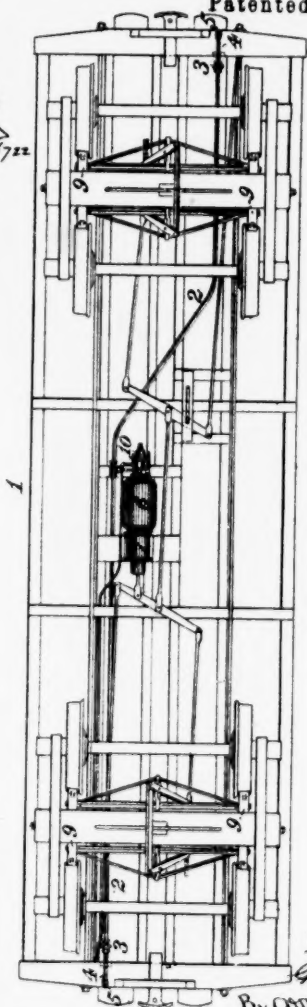


Fig. 1.

Witnesses
R. H. Whipple
C. M. Clarke

Inventor
George Westinghouse
By Attorney
J. Thomson Bell

(Model.)

3 Sheets—Sheet 2.

G. WESTINGHOUSE, Jr.

FLUID PRESSURE AUTOMATIC BRAKE MECHANISM.

No. 360,070.

Patented Mar. 29, 1887.

*Nos. 403 & 426.
Westinghouse Co. }
Dryden Co. }*

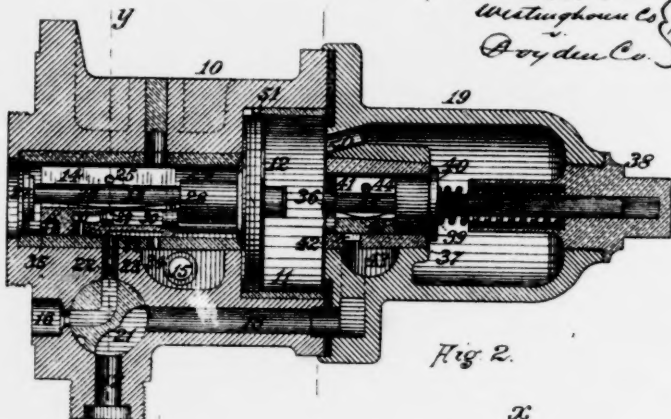


Fig. 2.

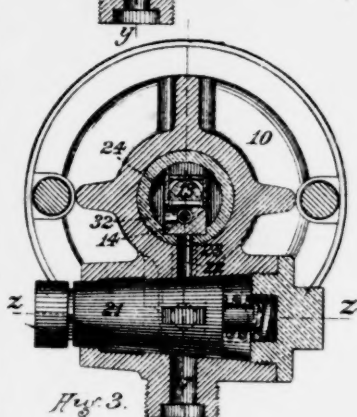


Fig. 3.

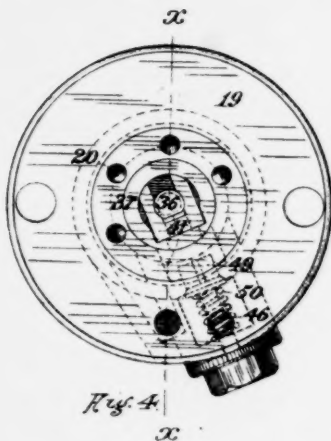


Fig. 4.

*Witnessed
R. H. Whittier
C. M. Clarke*

*Inventor
By Attorney
George Westinghouse Jr.
J. Thomson Bell*

(Model.)

3 Sheets—Sheet 3.

G. WESTINGHOUSE, Jr.

FLUID PRESSURE AUTOMATIC BRAKE MECHANISM.

No. 360,070.

Patented Mar. 29, 1887.

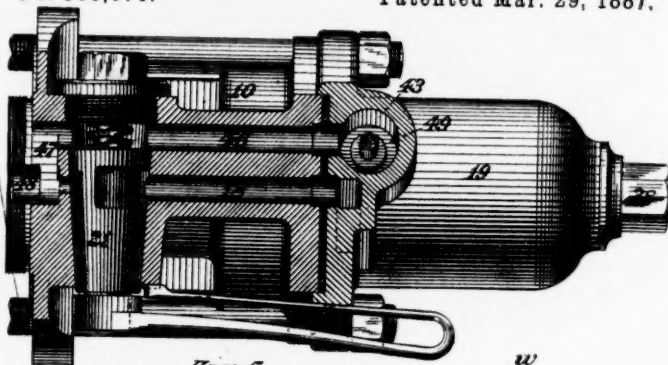


Fig. 5.

Nos 403 & 426
Westinghouse Co } p 726
v.
Bryden Co.

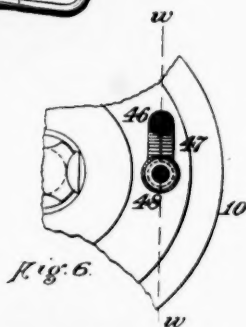


Fig. 6.

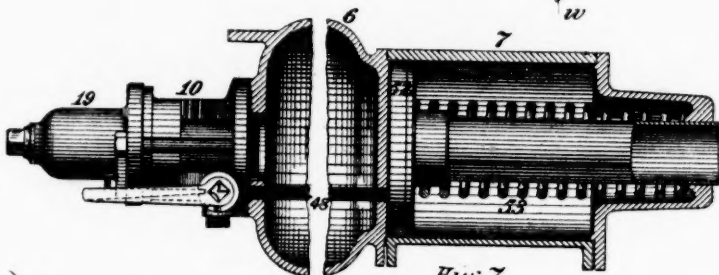


Fig. 7.

Witnesses
R. H. Whittlesay
C. M. Clarke

Inventor George Westinghouse
By Attorney J. Thomson Bell

the main air-pipes through the engineer's valve, thereby reducing the pressure in the main air-pipes, whereupon the then higher pressure in the auxiliary reservoirs moves the pistons of the triple valves, so as to first close the passages from the triple valves to the brake-pipe and at the same time close the release-ports of all the brake-cylinders, and then open the passages from the auxiliary reservoirs to the brake-cylinders, the pistons of which are forced out by the compressed air thereby admitted to the brake-cylinders, applying the brakes by means of suitable levers and connections, all of which mechanism is fully shown in various letters patent granted to me.

The application of the brakes with their full force has heretofore required a discharge of air from the main pipe sufficient to reduce the pressure in said pipe below that remaining in the auxiliary reservoir after the brakes have been fully applied, and it has been found that, while the brakes are sufficiently quick in action on comparatively short trains, their action on long trains of from thirty to fifty cars, which are common in freight service under present practice, is in a measure slow, particularly by reason of the fact that all the air required to be discharged from the main pipe to set the brakes must travel from the rear of the train to a single discharge-opening on the engine. This discharge of air at the engine has not only involved a serious loss of time in braking, but also a waste of air. Under my present invention a quicker and more efficient action of the brakes is obtained, and air which has been heretofore wasted in the application of the brakes is almost wholly utilized to act upon the brake-pistons.

In the accompanying drawings—

(Here follow diagrams marked pp. 722, 724, & 726.)

Figure 1 is an inverted plan view of a railroad-car, illustrating the application of my invention; Fig. 2, a longitudinal section, on an enlarged scale, through the triple valve at the line *x x* of Fig. 4; Fig. 3, a transverse section through the same at the line *y y* of Fig. 2; Fig. 4, a bottom plan view of the cap or drain-cup of the triple valve; Fig. 5, a longitudinal section through the triple valve at the lines *z z* of Fig. 3 and *w w* of Fig. 6; Fig. 6, a partial bottom plan view of the triple valve; and Fig. 7, a longitudinal central section through the brake-cylinder and auxiliary reservoir, with the triple valve in elevation.

In the practice of my invention each railroad car 1 on which it is applied is, as heretofore, provided with a main air-pipe, 2, governed by stop-cocks 3, adjacent to its ends, and having a flexible connection, 4, and coupling 5 at each end, to admit of being coupled to the main air-pipe of the tender or the adjacent car or cars of a train. An auxiliary reservoir, 6, and brake-cylinder 7 are secured in convenient position below the sills of the car, the brake-cylinder having a piston, 52, by the movement of which, through a system of lever-connections, which do not form part of my present invention, the brake-shoes 9 are applied to and released from the wheels of the car, compressed air being supplied to and released from the brake-

cylinder 7 as the pressure in the main air-pipe is reduced or reinstated, respectively, by means of a triple valve, 10, the casing or chest of which communicates with the main air-pipe, the auxiliary reservoir, and the brake-cylinder.

So far as the performance of its preliminary function in ordinary braking is concerned—that is to say, effecting the closure of communication between the main air-pipe and the auxiliary reservoir and the opening of communication between the auxiliary reservoir and the brake-cylinder in applying the brakes, and the reverse operations in releasing the brakes—the triple valve 10 accords substantially with that set forth in letters patent of the United States No. 220,556, granted and issued to me October 14, 1879, and is not, therefore, saying as to the structural features by which it performs the further function of effecting the direct admission of air from the main air-pipe to the brake-cylinder, as presently to be described, claimed as of my present invention. Certain of its elements devised and employed by me prior thereto will, however, be herein specified, in order to render its construction and operative relation to other members of the brake mechanism fully intelligible.

The case or chest in which the operative mechanism of the triple valve proper, 10, is mounted is fixed under or on the car-body in any convenient position relatively to the auxiliary reservoir 6 and brake-cylinder 7, being in this instance shown as secured directly to one end of the auxiliary reservoir, in line axially therewith and with the brake-cylinder, which is secured to its opposite end. The triple-valve case is fitted at one end with a cylindrical sleeve or bushing, 11, which is bored out truly and forms the chamber of a piston, 12, which is fixed upon a stem, 13, carrying, as in my letters patent No. 220,556, before mentioned, a slide-valve, 14, which controls communication between the auxiliary reservoir and the brake-cylinder, and between the brake-cylinder and release-port 15, respectively. The auxiliary reservoir 6 is continuously in communication with the chamber 11, on one side of the piston 12, through the longitudinal chamber 24 of the case in which the slide-valve 14 moves, and the triple-valve case communicates, by a passage, 16, with the brake-cylinder, and, by a passage, 17, with the main air-pipe 2. The passage 17, leading from the main air-pipe, communicates, by a passage, 18, with the cap or, as it is ordinarily termed, the "drain-cup" 19 of the triple valve, from which passages 20 lead into the piston-chamber 11. A four-way cock, 21, controls the passages 16, 17, 18, and a passage, 22, leading to a port, 23, in the face or seat of the slide-valve 14. When in the position shown in the drawings, communication is continuously maintained between the main air-pipe 2 and piston-chamber 11, through the passages 17 and 18, drain-cup 19, and passages 20, and by turning the cock 21, so as to establish communication between the passages 16 and 17, the triple valve and auxiliary reservoir will be cut out from the main air-pipe, and the mechanism can be operated as a non-automatic brake, the admission of air under pressure to the main air-pipe and brake-cylinder effecting, in such case, the application of the brakes.

The entire brake mechanism of the car other than the main air-pipe may be put out of action, when for any reason required, by turning the cock 21 into position to cover the passages 16 and 18, the main air-pipe then serving only for the transmission of air between the portions of the train-line made up by the main air-pipes of the remaining vehicles.

The slide-valve 14 is loosely connected with the stem 13 of the piston 12, and by a pin, 25, extending across the stem and fixed in the side plates of the valve, is prevented from being separated from the stem when removed for examination. It is held up to its seat in the chamber 24 by a spring, 26. The valve partakes in the reciprocating movements of the stem 13, being moved in one or the other direction by a collar, 27, and a shoulder, 28, respectively, on the stem. Said collar and shoulder are located at a distance apart slightly greater than the length of the valve 14, so that a limited degree of traverse of the stem 13 and piston 12 in each direction is effected without imparting movement to the valve. A graduating-valve, 29, secured upon a stem, 30, which is moved by the piston-stem, 13, governs a passage, 31, in the slide-valve 14, said passage communicating by a lateral port, 32, with the valve-chamber 24, and consequently with the auxiliary reservoir. A cavity or passage, 33, is formed on the face of the slide-valve 14, of such length as to establish communication during a portion of the traverse of the valve between the port 23 of the valve-chamber 24, which is open to the passage 16, leading to the brake-cylinder, and a port, 34, communicating with the relief-port 15.

The construction and relative arrangement of the piston-stem 13, slide-valve 14, and graduating-valve 29 are substantially similar to those of the corresponding parts as heretofore employed by me and exemplified in my letters patent No. 220,556; but under my present invention these are supplemented by a port, 35, leading from the end of the valve adjacent to the opening of the chamber 24, which communicates with the auxiliary reservoir, to the face of the valve, so as, at the limit of traverse of the piston-stem in the application of the brakes, to establish communication directly through said passage between the auxiliary reservoir and the port 23 and passages 22 and 16, leading to the brake-cylinder.

The piston-stem 13 abuts when the stem 13 and piston 12 are moved for the major portion of their traverse toward the drain-cup 19 against a stem, 36, which is fitted to slide freely in line axially with the stem 13 in an open-ended bushing, 37, in the end of the drain-cup 19 adjoining the piston-chamber 11, and in a guide formed in a screw-cap, 38, closing the opposite end of the drain-cup. A spring, 39, surrounding the stem 36 and bearing against the inside of the cap 38 and against a collar, 40, on the stem 36, maintains the latter in the position shown in Fig. 2, except when a sufficient pressure of air is admitted from the auxiliary reservoir to the piston-chamber to overcome the resistance of the spring and effect movement of the piston 12 beyond the point at which its stem 13 comes in contact with the stem 36.

So far as hereinbefore described, the triple valve accords in all

substantial particulars with and is adapted to operate similarly to those of my letters patent Nos. 168,359, 172,064, and 220,556, and, in order that it may perform the further functions requisite in the practice of my present invention, it is provided with certain additional members, which will now be described. For the purpose of effecting the admission of air directly from the main air-pipe 2 to the brake-cylinder 7 when it is desired to apply the brakes with great rapidity and full force, an auxiliary slide-valve, 41, is connected to and moves with the stem 36, said valve working over a face in the bushing 37 between the piston-chamber 11 and drain-cup 19, and governing a port, 42, in said face leading into a chamber, 43, adjoining the same. The valve 41 has lateral wings or plates fitting on each side of the stem 36, between shoulders or collars thereon, and is held thereto, when the stem is removed, between collars or shoulders thereon abutting against its ends, by a pin, 44, in its wings, a spring, 45, acting to hold it to its seat in the bushing 37 when in position. The chamber 43 communicates by a passage, 46, Fig. 5, with a chamber, 47, in the end of the case of the triple valve adjacent to the auxiliary reservoir, from which chamber a passage, 48, leads through the auxiliary reservoir into the brake-cylinder 7. The chamber 43 is further provided with a check-valve, 49, which opens outwardly into and controls the passage of air into the passage 46, said valve being held to its seat by a light spring, 50, and serving to prevent the return of air from the brake-cylinder when the pressure in the main air-pipe is reduced below that in the brake-cylinder, as in the case of the separation of the cars of the train by the breaking of a coupling.

In the operation of the brake mechanism as above described, air from the main reservoir and main air-pipe passes through the passages 17 18, drain-cup 19, and passages 20 into the piston-chamber 11, forcing the piston 12 to the left-hand extremity of its stroke and uncovering a small feeding-groove, 51, in the piston-chamber, through which air passes into the auxiliary reservoir 6 until the pressure in the latter is equal to that in the main air-pipe, the brake-cylinder being meanwhile in communication with the atmosphere through the passages 16 and 22, valve-cavity 33, and ports 23 34, and release-port 15. To apply the brakes in making ordinary stops, a portion of the air is discharged from the main air-pipe by the engineer's valve, thereby correspondingly reducing the pressure in the main air-pipe, whereupon the higher pressure in the auxiliary reservoir moves the piston 12 to the right, covering the feeding-groove 51, and thus preventing the return of air from the auxiliary reservoir to the main air-pipe, the movement of the piston continuing until arrested by the decrease of pressure in the auxiliary reservoir or by the stem 36 and its spring 39. The movement of the slide-valve 14 then closes the port 23, preventing escape of air from the brake-cylinder, and places the passage 31 partly or wholly in communication with the port 33. The small auxiliary valve 29 having been meanwhile unseated by the movement of the piston-stem, compressed air from the auxiliary reservoir passes through the lateral port 32 and passage 31 of the slide-valve 14 and the passages 22 and 16 of the triple-valve case to the brake-cylinder,

rearing out the piston, and, through an appropriate system of
 levers and connections, applying the brakes. When the pressure
 in the auxiliary reservoir has in this operation been reduced by
 expansion into the brake-cylinder until it is slightly below the
 pressure in the main air-pipe, the pressure on the air-pipe side of
 the piston 12 forces the piston 12 in the opposite direction until the
 auxiliary valve 29 closes the passage 31, thereby arresting the fur-
 ther flow of air from the reservoir to the brake-cylinder and holding
 the brakes with a force proportionate to the reduction of pressure
 in the brake-pipe. To release the brakes, the pressure in the main
 air-pipe is increased by admitting air from the main reservoir,
 whereupon the resultant increase of pressure in the piston-chamber
 11 forces the piston 12 back to its original or normal position,
 30 permitting the escape of air from the brake-cylinder 7, the
 piston 52 of which is returned to its position by a spring, 53,
 releasing in its backward movement the brake-shoes 9 from the
 wheels, and at the same time the auxiliary reservoir is recharged.
 The admission of air to the brake-cylinder through the passage 31,
 which is opened just before the piston-stem comes in contact with the
 graduating-stem, and which corresponds to the feed-passage hereto-
 fore employed, suffices for the ordinary requirements of braking
 in regular service. In the event, however, of its becoming necessary
 to apply the brakes with great rapidity and with their greatest
 available force, the engineer, by means of the valve at his command,
 instantly discharges sufficient air from the front end of the main
 air-pipe to effect a sudden reduction of pressure of about twenty
 pounds per square inch therein, whereupon the piston 12 of the
 triple valve is forced to the extreme limit of its stroke in the direc-
 tion of the drain-cup 19, carrying with it the stem 36 and auxiliary
 slide-valve 41, which instantly uncovers the port 42 and discharges
 air from the main air-pipe through the opening of the check-valve
 49 and the passages 46 and 48 to the brake-cylinder, and, each car
 being provided with one of these devices, it will be seen that they
 are successively moved with great rapidity, there being practically
 on a train of fifty cars fifty openings for discharging compressed air
 from the main pipe, instead of the single opening heretofore com-
 monly used. Not only is there a passage of considerable size opened
 from the brake-pipe on each car, whereby the pressure is more
 quickly reduced, but the air so discharged is utilized in the per-
 formance of preliminary work, it being found in practice that the
 air so taken from the pipe will exert a pressure of about twenty-
 five pounds in the brake-cylinders. When the piston 12 arrives at
 the extremity of its stroke, as above specified, the supplemental
 port 35 of the slide-valve 14 is brought into communication with
 the port 33 and passages 22 and 16, which serves to discharge the
 reservoir-pressure into the brake-cylinder, thereby augmenting the
 pressure already exerted in the brake-cylinder by the air admitted
 from the main air-pipe. Upon the reduction of the pressure in the
 main air-pipe below that in the brake-cylinders, as by the breaking
 in two of the train, the check valve 49 closes communication between
 the passages 46 and 18, thereby preventing the return of the air
 from the brake-cylinder to the main air-pipe. The feed-opening for

the admission of air from the auxiliary reservoir to the brake-cylinder is purposely made of comparatively small diameter, it having been determined by experiment that the initial application of the brakes should not be made with maximum force, and this opening may be made of such size as to apply the brakes exactly in accord with the requirements of the most efficient work.

In using the terms "triple valve" and "triple-valve device" I refer to a valve device, however specifically constructed, having a connection with the main air or brake pipe, another with an auxiliary reservoir or chamber for the storage of power, and another with a brake-cylinder or its equivalent for the utilization of the stored power and with a release or discharge passage for releasing the operative power from the brake-cylinder, whether the valves governing these passages or connections are arranged in one or more cases and are moved by a piston or its equivalent or by a series of pistons or their equivalents, there being numerous examples in the art of constructions varying materially in appearance whereby these functions are performed, both in plenum and vacuum brake mechanisms.

While I have herein described my invention as applied in a brake mechanism utilizing air under pressure, such as is in general and approved use, I do not desire to limit myself to brakes so operated, as my improvements are likewise susceptible of application, without variation of principle, in connection with brakes worked by atmospheric pressure.

I am aware that a construction in which "an always-open one-way passage" from the main air-pipe to the brake-cylinder is uncovered by the piston of the triple valve simultaneously with the opening of the passage from the auxiliary reservoir to the brake-cylinder has been heretofore proposed, and such construction, which involves an operation different from that of my invention, I therefore hereby disclaim.

I claim as my invention and desire to secure by letters patent—

1. In a brake mechanism, the combination of a main air-pipe, an auxiliary reservoir, a brake-cylinder, a triple valve, and an auxiliary-valve device, actuated by the piston of the triple valve and independent of the main valve thereof, for admitting air in the application of the brake directly from the main air-pipe to the brake-cylinder, substantially as set forth.

2. In a brake mechanism, the combination of a main air-pipe, an auxiliary reservoir, a brake-cylinder, and a triple valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake-cylinder, and which by a further traverse admits air directly from the main air-pipe to the brake-cylinder, substantially as set forth.

3. In a brake mechanism, the combination of a main air-pipe, an auxiliary reservoir, a brake-cylinder, and a triple valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake-cylinder, and which by a further traverse admits air directly from the main air-pipe to the brake-cylinder and effects a second admission of air from the auxiliary reservoir to the brake-cylinder, substantially as set forth.

4. The combination, in a triple-valve device, of a case or

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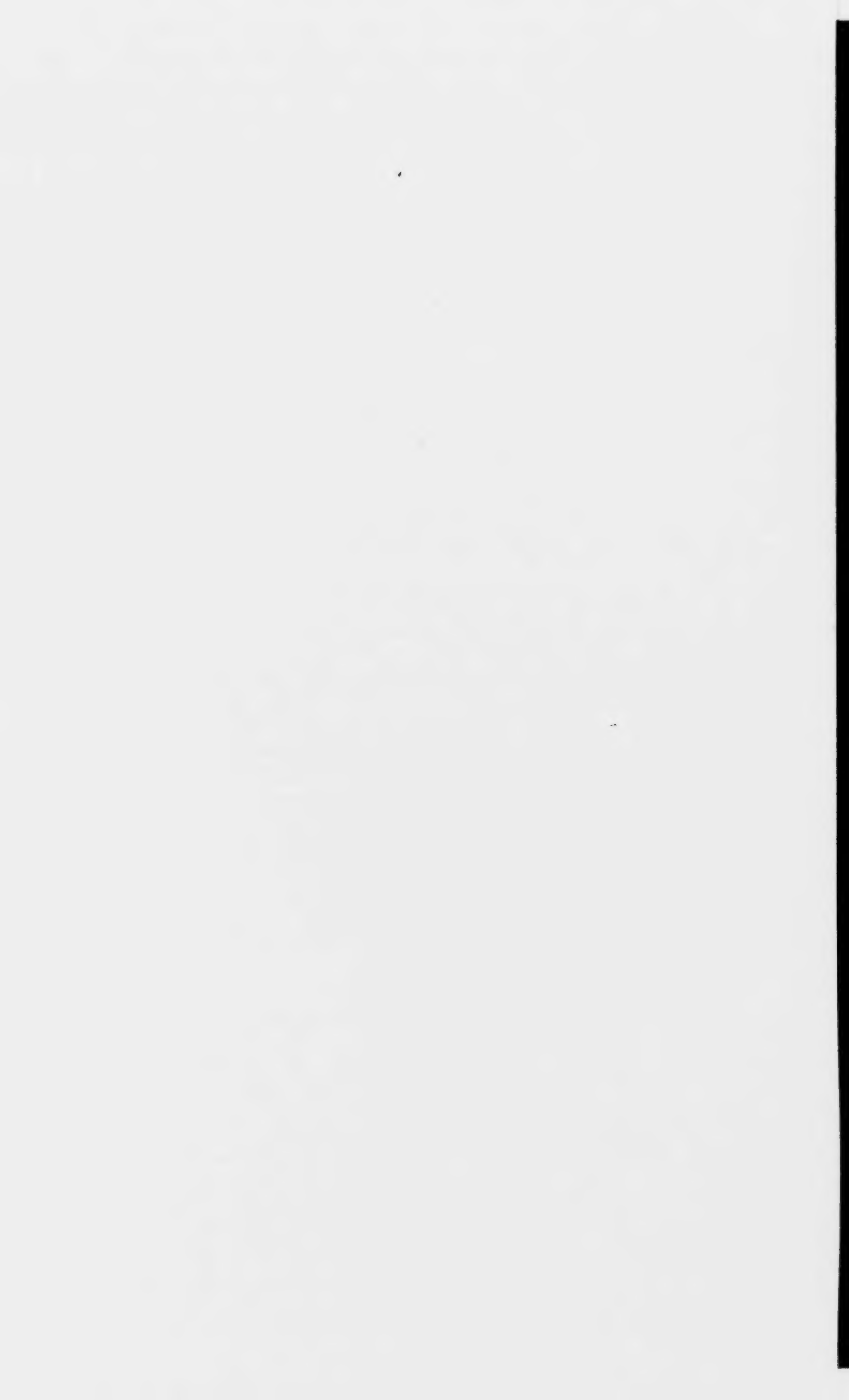
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731 chest, a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston-stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere, respectively, and an auxiliary valve actuated by the piston-stem and controlling communication between passages leading to connections with a main air-pipe and with the brake-cylinder, respectively, substantially as set forth.

5. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston-stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere, respectively, an auxiliary valve, actuated by the piston-stem and controlling communication between passages leading to connections with a main air-pipe and with the brake-cylinder, respectively, and a check or non-return valve interposed between the auxiliary valve and the passage leading therefrom to the brake-cylinder, substantially as set forth.

6. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston-stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere, respectively, an auxiliary stem mounted in the cap of the case in position to be moved longitudinally by the piston-stem in the latter portion of its traverse in the direction required for the application of the brakes, a spring bearing against a collar on the auxiliary stem and against a fixed abutment, and an auxiliary valve connected to the auxiliary stem and controlling communication between passages leading to connections with a main air-pipe and with the brake-cylinder, respectively, substantially as set forth.

7. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, an auxiliary valve actuated by the piston-stem and controlling communication between passages leading to connections with a main air-pipe and with a brake-cylinder, respectively, and a main valve connected to the piston-stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere, respectively, said main valve having a supplemental port or passage which establishes communication between the auxiliary reservoir and brake-cylinder connections at or near the limit of the traverse of the main valve in effecting the application of the brake under maximum pressure, substantially as set forth.

In testimony whereof I have hereunto set my hand.

GEO. WESTINGHOUSE, JR.

Witnesses:

J. SNOWDEN BELL.

R. H. WHITTLESEY.

CHARLES H. PERKINS, of Bloomington, Illinois, assignor to George Westinghouse, Jr., of Pittsburg, Pennsylvania.

Improvement in Valves for Air-brakes.

Specification forming part of Letters Patent No. 163,242, dated March 11, 1875; application filed March 13, 1875.

To all whom it may concern :

Be it known that I, C. H. Perkins, of Bloomington, in the county of McLean and in the State of Illinois, have invented certain new and useful improvements in valves for air-brakes; and do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings making a part of this specification, in which—

(Here follows diagram marked p. 758.)

Figure 1 is a central longitudinal section of my improved apparatus, showing the relative position of parts before air-pressure is applied. Fig. 2 is a like view of the same after pressure is applied and while the operative parts are in a state of equilibrium, and Figure 3 shows the position of said operative parts after such equilibrium has been destroyed and air is passing to the brake-cylinder.

Letters of like name and kind refer to like parts in each of the figures.

The design of my invention is to render more simple and efficient the means employed for controlling the admission of air to the cylinder of pneumatic car-brakes; to which end it consists, principally, in the combination of the piston-valve with the cylindrical valve-box, having its inlet, outlet, and exhaust ports relatively arranged in the manner and for the purpose substantially as is hereinafter specified.

It consists, further, in combining, with one end of said main valve, a spiral spring, for pressing it toward one end of the valve-box, when not otherwise adjusted, by air-pressure, substantially as and for the purpose hereinafter set forth.

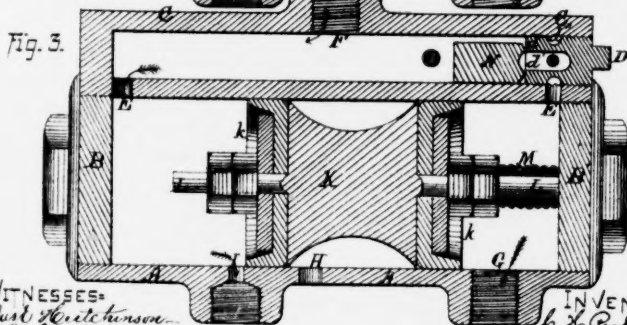
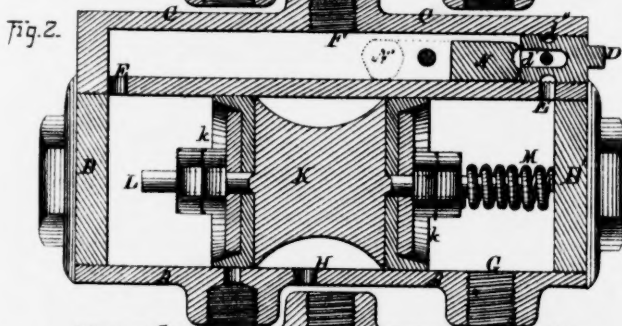
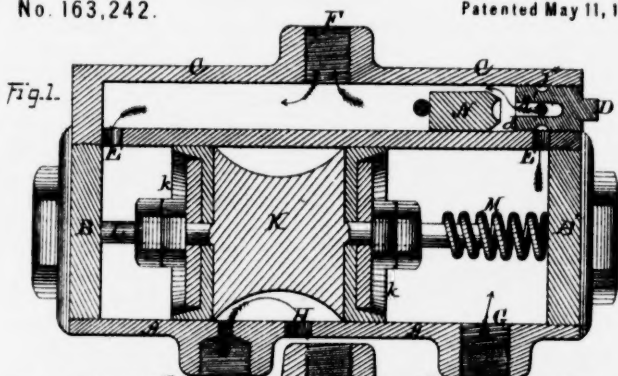
In the annexed drawings, A represents the box or casing of main valve, constructed in the form of a hollow cylinder, and having its ends closed by means of removable heads B and B'. Upon the upper side of the cylinder A is formed a second supplemental cylinder, C, which corresponds in length to the same, and has about one-fourth its diameter. One end of said upper cylinder C is permanently closed, while its opposite end is closed by means of a removable screw-plug, D. Small ports E and E' are provided between the ends of the cylinders A and C, an opening, F, is formed at the upper side and longitudinal center of the latter, while three openings, G, H, and I, respectively, are provided within the lower

nos 403 & 426
Westinghouse Co } p. 758
Boydell Co.

C. H. PERKINS.
Valve for Air-Brakes.

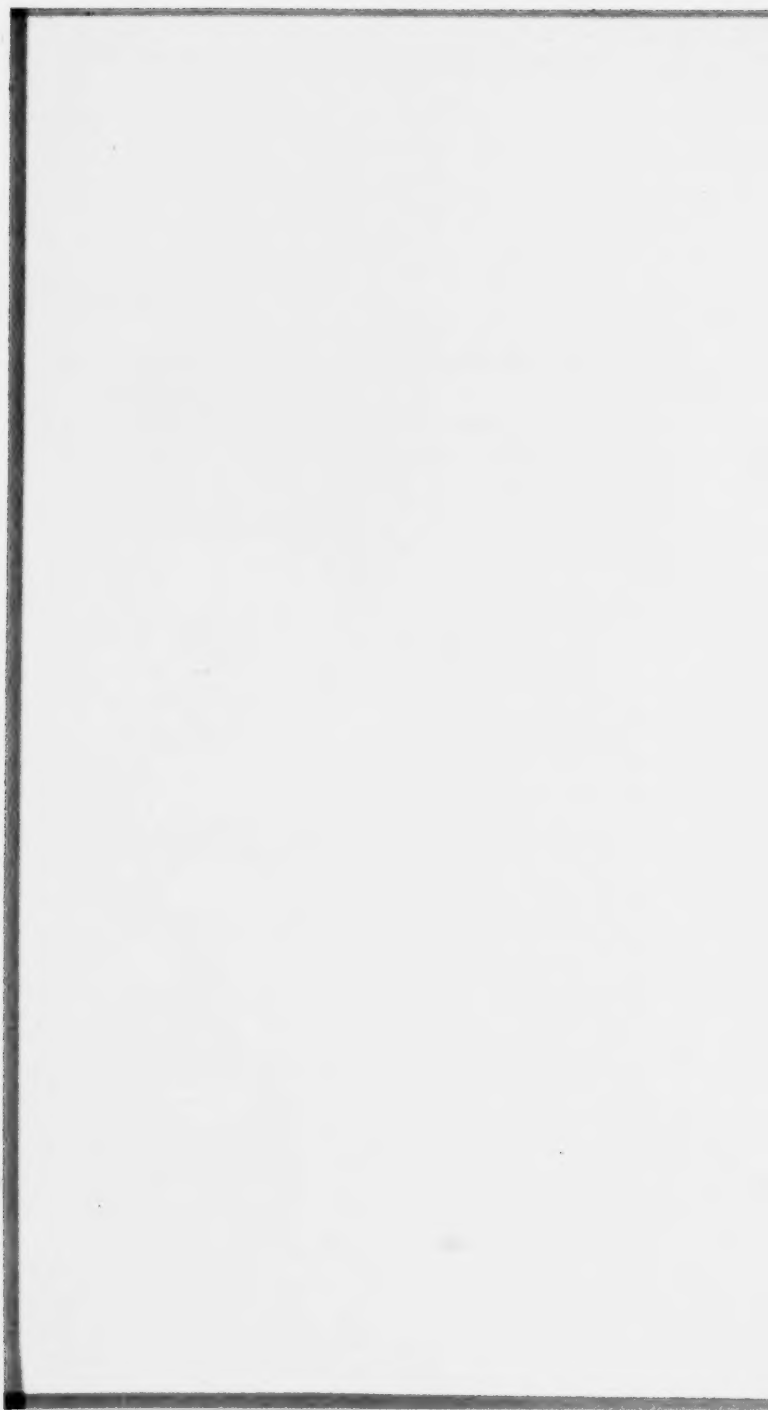
No. 163,242.

Patented May 11, 1875.



WITNESSES:
Jas. Hutchinson
John R. Young

INVENTOR
C. H. Perkins
by C. H. Perkins



side of said main cylinder A, as shown, the first of said openings G being located near one end, the second opening H at a point just beyond the longitudinal center of said cylinder, while the third opening I is located at a point about one-third of the length of said cylinder from its opposite end. Within the cylinder A is placed a piston-valve, K, which has the form shown; is packed with leather *k* at each end; and is provided with a central rod, L, which extends outward from either end, and, by contact with the heads B and B', limits the travel of said valve. A spiral spring, M, placed around one end of said rod L, bears against the head B and the end of said valve, and presses the latter to the center, longitudinally of said cylinder, as seen in Fig. 2. Upon the inner end of the plug D, which extends inward beyond the port E, is formed a seat, *d*, which, at its center, is provided with an opening, *d'*, that extends longitudinally into said plug, and then radially outward into a concentric cavity, *d''*, that is formed by grooving said plug. The space *d''* is directly over the port E, so that air passing from the cylinder A through said port can, by means of said space and the opening *d'*, enter the valve-box C. A valve, N, is fitted within the box C, and allowed such longitudinal motion therein as to enable the opening *d'* to be uncovered, as seen in Fig. 1; or, by the seating of said valve, to be closed, as shown by Fig. 2 and 3.

The device is now complete, and being placed beneath a car with the opening G in communication with the air-supply pipe, the opening F in communication with the air-tank, and the opening I in communication with the brake-cylinder, operates as follows: The normal position of parts is, as shown in Fig. 1, the main valve K being thrown beyond the center of its casing A, so as to connect the parts I and H and permit air to escape from the brake-cylinder, which position remains unchanged as air from the pump is admitted through the opening G into said casing, and from the same passes through the port E and passage *d'* into the valve-box C, from 760 the latter through the opening F into the tanks, and through the port E' into the opposite end of the main valve-box, the pressure of air upon opposite ends of said valve K being just equal. When it is desired to apply the brake, the pressure within the supply-pipe and front end of the valve-box A is decreased, when the pressure within the opposite end of the latter will move the valve K to the position shown in Fig. 3, so as to uncover the outlet-port I and permit air to pass into the brake-cylinder. When the quantity of air passing into the brake-cylinder has been sufficient to cause the pressure within the rear end of the valve-box A and the tank to nearly equal the pressure within the opposite end of said valve-box, the spring M will force the valve K to the central position shown in Fig. 2, and cover the outlet-port I, so as to prevent the escape of air from the brake-cylinder, and cause the pressure of the brake upon the wheels to be maintained. While the brake is on, and the main valve occupies the position shown in Fig. 2, the pressure within the tank may be gradually increased. If it is desired to apply more power to the brake, the pressure within the supply-pipe is again decreased, when the main valve will be again

forced to the position shown in Fig. 3, and air admitted to the brake-cylinder until the pressure upon opposite ends of said valve is equalized as before. To let off the brakes, air-pressure is again applied to the supply-pipe, and through the same to the front end of the main valve-box A, and, when such pressure equals that within the opposite end of the latter, the spring M will force the main valve K in the opposite direction, the port I will be cut off from communication with the air-tank and placed in communication with the exhaust-port H, when the air within the brake-cylinder will escape.

The device described is simple in construction, certain and efficient in operation, and enables the desired work to be performed by use of a smaller number of parts than are usually employed.

Having thus fully set forth the nature and merits of my invention, what I claim as new is—

1. In combination with the valve-box A, provided with the inlet-port G, outlet-port I, and exhaust-port H, and connected through suitable mechanism with an air-pressure tank, the valve K, arranged to move longitudinally within said valve-box, having greater width of bearing than, and capable of covering and uncovering, said outlet-port I, and of connecting the same with said exhaust-port H, substantially as and for the purpose specified.

2. In combination with the valve-box A and valve K, the spring M, placed between one end of said valve-box and said valve, and having such length as to cause said valve to cover the outlet-port whenever the air-pressure upon its ends is equal, substantially as and for the purpose shown.

In testimony that I claim the foregoing I have hereunto set my hand this 8th day of March, 1875.

CHARLES H. PERKINS.

Witnesses:

I. E. EASTMAN.

FRANK. WHITE.

761 "COMPLAINANTS' EXHIBIT BRITISH PATENT 3000 OF 1879."

A. D. 1879, 23d July. No. 3000.

Brakes.

Letters patent to Edward Dunning Barker, of 45 Bedford row, in the county of Middlesex, for the invention of "improvements in automatic brakes worked by fluid pressure."

Sealed the 20th January, 1880, and dated the 23rd July, 1879.

Provisional specification left by the said Edward Dunning Barker at the office of the commissioners of patents on the 23rd July, 1879.

EDWARD DUNNING BARKER, of 45 Bedford row, in the county of Middlesex.

"Improvements in Automatic Brakes Worked by Fluid Pressure."

The object of this invention is to enable brakes that are automatic in their action (or which are self-applied if the train becomes disconnected) to be used effectually in the ordinary working of trains. For this purpose it is requisite that the brakes should be capable of being applied with greater or less force, and that provision should be made for increasing or diminishing this force at the pleasure of the engine driver or operator.

In the automatic brakes at present in use, air or other fluid is stored under pressure in reservoirs upon the carriages, and when the brakes have to be applied, the fluid is allowed to pass from the reservoirs into the brake-cylinders; valves being then permitted to open by the reduction of the pressure in a main pipe laid along the train. There is a small piston in connection with each valve, and when the piston is thus relieved from pressure on one side it yields to a counter-pressure on the other side, thereby moving the valve and permitting the fluid to flow from the reservoir to the
762 cylinder. When the pressure in the main pipe is restored the piston operates to close the communication between the reservoir and the brake-cylinder, and to open a passage for the escape of the air or fluid from the brake cylinder.

Now in such automatic brakes, in order that the amount of pressure upon the brake may be completely under control, I employ a regulating cylinder in communication with the brake-cylinder, and containing another piston also connected with the admission and exhaust valve of the brake-cylinder. When there is pressure within the brake-cylinder this pressure operating on the piston in the regulating cylinder acts in conjunction with the pressure in the main pipe to hold the valve closed to the passage of fluid from the reservoir to the brake-cylinder, and open for the escape of fluid

from the brake-cylinder. With this arrangement a reduction of pressure in the main pipe first causes the valve to open as usual for the passage of air or fluid from the reservoir into the brake-cylinder, but this only continues until the pressure in the brake-cylinder is such that acting in the regulating cylinder in aid of the pressure on the valve piston, the two together suffice to close the valve again against the passage of fluid from the reservoir to the brake-cylinder.

Thus the pressure in the brake-cylinder is at all times dependent on the pressure in the main pipe, and whatever may be the pressure in the brake-cylinder at any time a slight increase in the pressure in the main pipe (which is under the direct control of the engine driver or operator) causes a corresponding diminution of the pressure in the brake-cylinder; and a decrease in the pressure in the main pipe causes a corresponding increase of pressure in the regulating cylinder and in the brake cylinder.

Regulating cylinders may be applied in the manner I have described to the existing valves of automatic brakes, but I prefer the following arrangement: I employ two pistons of different sizes formed in one piece or fixed on the same rod; these pistons are received into a cylinder bored to two diameters to fit the pistons. The main pipe communicates with the end of the cylinder in which the smaller piston works. There is also an aperture 763 in this part of the cylinder by which the air or fluid can pass from the cylinder past a check-valve (which prevents return) into a valve box on the side of the cylinder, and from this valve box by a pipe to the reservoir. The valve box contains a slide-valve working over *over* two ports, one being an opening into the centre part of the cylinder or to the space between the two pistons, which space is always in communication with the brake-cylinder; and the other being an outlet passage by which the fluid is allowed to escape from the brake-cylinder when it is necessary to reduce the pressure upon the brake-blocks. The valve moves with the pistons with which it is connected by a stud or projection passing through the first-mentioned port or passage. A coiled spring abuts upon the larger piston, tending to force the pistons to the end of the cylinder, at which the air or fluid under pressure enters it from the main pipe. When the fluid in the main pipe is at the full working pressure the spring is overcome and the pistons are pressed back; the valve is thus placed in such a position that the centre space between the pistons is in communication with the exhaust passage, so that no pressure is retained either here or in the brake-cylinder. Hence at this time the brakes are off, and the reservoir is charged under pressure. When a reduction is made in the pressure in the main pipe the pistons move under the influence of the spring carrying the valve with them, thereby closing the exhaust passage and opening the port by which fluid enters between the pistons; the passage of fluid from the reservoir to the brake-cylinder is thus permitted. As the pressure accumulates between the pistons however it acts on the piston of the larger area in such manner as to aid in compressing the spring, and when a sufficient compensation is thus

obtained for the reduction of pressure which has been made in the main pipe the pistons return carrying back the valve, so that no further rise of pressure in the brake-cylinder can take place until a further reduction of pressure is made in the main pipe. On the other hand when the pressure in the main pipe is increased the pistons and valve move in the contrary direction; and fluid is permitted to escape from the brake-cylinders, reducing the pressure therein or relieving it entirely so as to take off the brakes

764 Specification in pursuance of the conditions of the letters patent filed by the said Edward Dunning Barker in the Great Seal patent office on the 23d January, 1880.

EDWARD DUNNING BARKER, of 45 Bedford row, in the county of Middlesex.

"Improvements in Automatic Brakes Worked by Fluid Pressure."

The object of this invention is to enable brakes that are automatic in their action (or which are self-applied if the train becomes disconnected) to be used effectually in the ordinary working of trains.

For this purpose it is requisite that the brakes should be capable of being applied with greater or less force, and that provision should be made for increasing or diminishing this force at the pleasure of the engine driver or operator.

In the automatic brakes at present in use air or other fluid is stored under pressure in reservoirs upon the carriages, and when the brakes have to be applied the fluid is allowed to pass from the reservoirs into the brake-cylinders, valves being then permitted to open by the reduction of the pressure in a main pipe laid along the train. There is a small piston in connection with each valve, and when the piston is thus relieved from pressure on one side it yields to a counter-pressure on the other side, thereby moving the valve and permitting the fluid to flow from the reservoir to the brake-cylinder. When the pressure in the main pipe is restored the piston operates to close the communication between the reservoir and the brake-cylinder, and to open a passage for the escape of the air or fluid from the brake-cylinder.

Now in such automatic brakes in order that the amount of pressure upon the brakes may be completely under control, I employ a regulating cylinder in communication with the brake-cylinder, and containing another piston also connected with the admission and exhaust valve of the brake-cylinder. When there is pressure within the brake-cylinder, this pressure operating on the piston in the regulating cylinder acts in conjunction with the pressure in the main pipe to hold the valve closed to the passage of fluid from the reservoir to the brake-cylinder, and open for the escape of

767 fluid from the brake-cylinder. With this arrangement a reduction of pressure in the main pipe first causes the valve to open as usual for the passage of air or fluid from the reservoir into the brake-cylinder, but this only continues until the pressure

in the brake-cylinder is such that acting in the regulating cylinder in aid of the pressure on the valve piston, the two together suffice to close the valve again against the passage of fluid from the reservoir to the brake-cylinder. Thus the pressure in the brake-cylinder is at all times dependent on the pressure in the main pipe, and whatever may be the pressure in the brake-cylinder at any time, a slight increase in the pressure in the main pipe (which is under the direct control of the engine driver or operator) causes a corresponding diminution of the pressure in the brake-cylinder; and a decrease in the pressure in the main pipe causes a corresponding increase of pressure in the regulating cylinder and in the brake-cylinder.

In the drawing hereunto annexed I have shewn four ways of arranging the valve apparatus of automatic brakes to act in the manner above described; this valve apparatus is fitted upon each of the carriages of a train that is furnished with automatic brake apparatus.

(Here follows diagram marked p. 765.)

In the arrangement shewn at figure 1, A is the inlet from the main pipe which passes from end to end of a train, and contains air or other fluid under pressure; B is the outlet to which is attached a pipe leading to the cylinders of the brake apparatus of the carriage upon which the valve apparatus is fitted; C is the passage communicating with a reservoir in which air or other fluid is stored up under pressure; and D is the outlet or exhaust passage by which the air or fluid is allowed to escape from the pipe B which leads to the brake-cylinders.

The air or other fluid under pressure passing in through the inlet A enters the lower part of a cylinder E, in which is a piston F; the upper part of this cylinder is bored to a larger diameter, and in it is a piston G which forms the regulating piston; the pistons are as shewn fixed or formed on one rod, and above the larger piston is a coiled spring H which tends always to force the pistons downwards. The spring is contained within a cap which closes the top of the cylinder E as shown. From the bottom of the cylinder E is formed a small passage I, by which air or fluid can pass from the cylinder E to a valve chamber J; the passage I is fitted with a stop-valve as shewn, to prevent any air or fluid which has entered the valve chamber from passing back to the bottom of the cylinder E. In the valve chamber J is also a slide-valve K, which in the position shewn in the drawing closes a passage from the valve chamber to the central part of the cylinder E intermediate of the two pistons which it contains, and in the arrangement shewn in this figure the slide-valve is also formed to at the same time open an exhaust passage D, so allowing air or fluid under pressure to escape from this part of the cylinder and from the pipe which passes from this part of the cylinder to the cylinders of the brake apparatus. The stem of the pistons F, G, is connected by a pin L with the slide-valve K, so that when the pistons are forced downwards by the coiled spring H the slide-valve is moved downwards also, and then

FIG. 4.

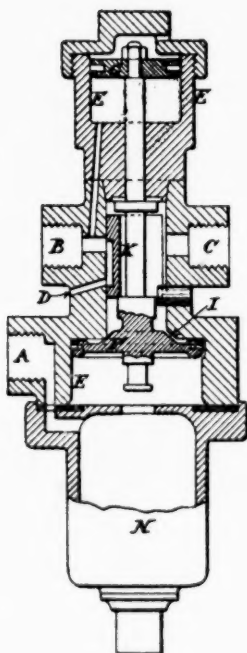
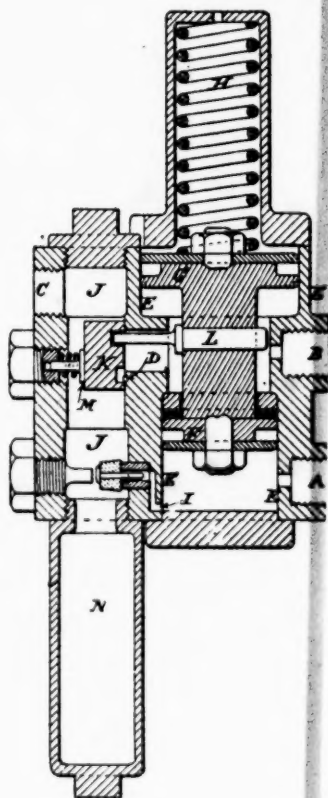


FIG. 1.





closes the communication between the central portion of the cylinder and the exhaust passage, and opens a communication between this part of the cylinder and the reservoir containing air or fluid under pressure, so that this air may pass to the pipe leading to the brake-cylinders, and so cause the brakes to be applied. The slide-valve is held up to the valve seat against which it works by a small plate M pressed against the back of the valve by a coiled spring. At the bottom of the valve-chamber is a receptacle N in which if air under pressure is the fluid being used for applying the brakes any water which may be deposited from the air may collect. This receptacle may from time to time be unscrewed and emptied.

The action of the apparatus is as follows:

When air under pressure enters the inlet A it acts against the under side of the piston F, and also passes through the passage I and to the air reservoir and brake-cylinders; when the pressure on the two pistons F and G is sufficiently high to overcome the pressure of the spring H, the pistons lift into the position shewn in the drawing. Air then continues to pass through the passage I and so to the reservoir, and as the pressure rises below the piston F, 769 the piston again lifts and opens the exhaust until the downward pressure of the spring again exceeds the sum of the pressures on the two pistons, and this goes on until the pressure on the bottom of the piston F is sufficient of itself to overcome the spring; there is then a free exit for air from the brake-cylinders, whilst the pressure of air in the reservoir is maintained at the same pressure as the air in the main pipe. When however the pressure in the main pipe is reduced by letting air escape from it, the spring H forces the pistons downwards and shifts the slide-valve so that air may pass from the reservoir to the cylinders of the brake apparatus, and so soon as the pressure of the air passing to the brake-cylinders and also acting on the under side of the piston G is sufficient when added to the diminished pressure acting on the under side of the piston F to overcome the spring H the pistons again rise and shift the slide-valve, so as to cut off any further supply of air under pressure to the brake-cylinders. Thus if the effective area of the piston G is the same as the area of the bottom piston, and the pressure of air in the main pipe is reduced, say, from 60 lbs. to 30 lbs. to the inch, the pistons would be forced down by the spring H and air under pressure would pass to the brake-cylinders until the pressure of air in these cylinders had risen to 30 lbs. to the inch, the sum of the pressures on the pistons F and G would then overcome the spring H, and all further supply of air under pressure would be cut off from the brake-cylinders, and the acting pressure in these cylinders would cease to increase. Thus the pressure of air in the pipe passing to the cylinders used for applying the brakes to the wheels will be controlled by the pressure of air in the main supply pipe, and when the pressure in the main supply pipe acting on the under side of the piston is sufficient by itself to overcome the spring H, the pressure of air in the pipe leading to the brakes becomes the same as the pressure of the external air.

A precisely similar arrangement of apparatus to that above de-

scribed is shewn at figure 2, except that in the arrangement shewn at figure 2 diaphragms are used in place of pistons.

The arrangement shewn at figure 3 differs from that shewn at figure 1 in that the slide-valve K is used only to control the passage of air from the air reservoir to the pipe leading to the
 770 brake-cylinders, whilst the escape of air from the pipe leading to the brake-cylinders is controlled by a separate valve O pressed down towards its seat by a coiled spring P, and held up from its seat by the pressure of air in the pipe leading to the brake-cylinders, and also by the pressure of air in the main supply pipe acting upon the bottom of a piston Q contained within a cylindrical cavity in the piston F. When the sum of the pressures upon the under side of the piston Q and the valve O are sufficient to overcome the spring P the valve O opens, but when the sum of the upward pressures is less than the downward pressure of the spring the valve closes. Thus the action of the apparatus will be precisely the same as the action of the one first described. The only difference is that in the arrangement first described one regulating piston G is used to control, not only the supply of air to the pipe leading to the brake-cylinders, but also the exit of air from this pipe; whereas in the arrangement shewn in figure 3 it only controls the supply of air to the pipe, and the exit of air from the pipe is controlled by a separate valve and regulating piston. The strength of the springs H and P should be so proportioned that the valve O shall remain closed until the sum of the pressures on the two pistons is somewhat more than sufficient to close the inlet slide-valve.

The arrangement shewn at figure 4 shows how the valve apparatus of what is known as the Westinghouse brake may have a regulating cylinder combined with it to enable the apparatus to be used as above described, so that in the ordinary working the pressure of air used for applying the brakes can be controlled and varied with the greatest ease. The same letters of reference are used as in the former figures.

When the pressure of air in the main supply pipe acts on the bottom of the piston F it holds up this piston in the position shewn. Air can then leak past the piston by the small passage I and fill the air reservoir. Afterwards if the pressure in the main supply pipe is rapidly lowered the pressure of air acting on the top of the piston is greater than on the bottom, and the piston is forced down. This shifts the slide-valve and permits air to pass from the air
 771 reservoir to the pipe leading to the brake-cylinders, and also, as the drawing shews, to a cylinder in which the regulating piston G works, and when the combined pressures upon the under sides of the pistons F and G are greater than the pressure of air upon the top of the piston F the pistons will again rise and shift the slide-valve, so controlling the pressure at which the air is allowed to act in the cylinders by which the brakes are applied, as in the arrangements of apparatus previously described.

Having thus described the nature of my invention and the manner of performing the same, I would have it understood that I do not

confine myself to the precise arrangements of mechanism shewn in the drawings hereunto annexed, but I claim,—

First. The construction of automatic brake apparatus with a regulating piston or diaphragm acting substantially in the manner hereinbefore described to control the passage of air or other fluid from each of the several air or fluid reservoirs on the several carriages to the pipes leading to the cylinders of the mechanism by which the brakes are applied.

Second. The construction of automatic brake apparatus acting substantially in the manner hereinbefore described.

Third. The construction of automatic brake apparatus, substantially in the ways hereinbefore described and shewn in the drawings annexed.

In witness whereof, I, the said Edward Dunning Barker, have hereunto set my hand and seal, this twenty-second day of January, in the year of our Lord one thousand eight hundred and eighty.

EDWARD D. BARKER. [L. S.]

772

COMPLAINANTS' EXHIBIT "LICENSE No. 1."

Filed July 10, 1893.

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE.

To all persons to whom these presents shall come, Greeting:

This is to certify, that the annexed is a true copy from the records of this office of an instrument of writing by George Westinghouse, Jr., and the Westinghouse Air Brake Company, November 22, 1880, and recorded in Liber Q 26, page 36.

Said record has been carefully compared with the original and is a correct transcript of the whole thereof.

In testimony whereof, I, Benton J. Hall, Commissioner of Patents, have caused the seal of the Patent Office to be affixed, this [SEAL.] 15th day of June, in the year of our Lord one thousand eight hundred and eighty-seven, and of the Independence of the United States the one hundred and eleventh.

BENTON J. HALL,
Commissioner.

Articles of agreement made and entered into this
Liber Q 26, 22d day of November, 1880, by and between
p. 36. George Westinghouse, Jr., of Pittsburgh, Penn-
sylvania, party of the first part, and the Westing-
house Air Brake Company, a corporation organized under the
laws of the State of Pennsylvania and having its principal place
of business at Pittsburgh aforesaid, party of the second part.

Whereas, letters patent of the United States have been granted to George Westinghouse, Jr., as follows:

No. 124,404, March 5th, 1872, for improvement in steam-power air brakes and signals.

773 No. 124,405, March 5th, 1872, for improvement in steam air brakes.

No. 134,177, December 24th, 1872, for improvement in steam and air brakes.

No. 138,827, May 13th, 1873, for improvement in valve devices for steam and air brakes.

No. 141,685, August 12th, 1873, for improvement in valve devices for fluid brakes.

No. 144,006, October 28th, 1873, for improvement in steam and air brakes.

No. 149,901, April 21st, 1874, for improvement in valves for fluid brake-pipes.

No. 156,322, October 27th, 1874, for improvement in discharge valve for fluid brakes.

No. 156,323, October 27th, 1874, for improvement in tripping apparatus for air brakes.

No. 168,359, October 5th, 1875, for improvement in air valves for power brakes.

No. 172,064, January 11th, 1876, for improvement in air-brake valves.

No. 214,336, April 15th, 1879, for improvement in coupling valves.

No. 214,602, April 22d, 1879, for improvement in cocks for fluid pressure brakes.

No. 214,603, April 22d, 1879, for improvement in railway air-brake apparatus.

No. 216,545, June 17th, 1879, for improvement in operating valves for steam and air brakes.

No. 217,836, July 22d, 1879, for improvement in fluid-pressure brake apparatus.

No. 217,838, July 22d, 1879, for improvement in automatic brake relief valves.

No. 218,150, August 5th, 1879, for improvement in automatic brake attachments.

No. 220,556, October 14th, 1879, for improvement in regulating valves for automatic brakes.

No. 157,951, December 22d, 1874, for improvement in pipe coupling. Reissued June 18th, 1878. Reissue No. 8291.

774 No. 134,408, December 31st, 1872, for improvement in steam and air brakes. Reissued February 22d, 1876. Reissue No. 6948.

No. 180,179, July 25th, 1876, for improvement in air brake and signal.

No. 214,337, April 15th, 1879, for improvement in automatic brake-regulators.

No. 217,837, July 22d, 1879, for improvement in piston diaphragms for power brakes.

No. 218,149, August 5th, 1879, for improvement in fluid-pressure brake apparatus.

Which said patents relate in general terms for the most part to a system of railway brake apparatus commonly known as the West-

inghouse automatic brake, which said brake apparatus, the said Westinghouse Air Brake Company, in addition to the business for which it was principally organized, has been making and selling as licensee at will of the said George Westinghouse, Jr., and under terms and at prices prescribed by him.

And whereas, the said The Westinghouse Air Brake Company desires to acquire the exclusive right to manufacture such automatic brake apparatus for passenger-locomotive and passenger-car service (with or without further improvements), and desired to procure authority to make sales of the apparatus so made, which authority the said Westinghouse is willing to grant under certain terms, conditions and limitations (but not otherwise) all as hereinafter set forth.

And whereas, certain schedule prices for the said "automatic" apparatus when sold in sets for passenger-locomotive and passenger-car service have been prescribed by the said George Westinghouse, Jr., as set forth in the printed form of agreement now in use by the said company in its dealings with its vendees, and also certain other prices for the patented parts of sets when sold for use in making repairs of full sets previously sold, which schedule prices for sets are to be hereafter maintained unless modified by consent of the said Westinghouse, and which prices of parts of sets are to be varied only in conformity with the varying cost of labor and materials employed in making the same.

775 Now these presents witness that the said George Westinghouse, Jr., for and in consideration of the sum of one dollar to him in hand paid by the said The Westinghouse Air-brake Company, at or before the execution or delivery hereof, and for other good and valuable considerations him hereunto moving, has given and granted and does hereby give and grant to the said The Westinghouse Air Brake Company, its successors, legal representatives and assigns, the exclusive right and license under each and all of the above-recited patents, to manufacture "automatic" brake apparatus, suitable for passenger-locomotive and passenger-car service (but not to sell the same except as hereinafter specified, nor to use the same except for the purpose of testing the machinery so manufactured by them, and for experimenting therewith) to the full end and expiration of the respective terms of the said patents and also a like restricted right under any patents for further improvements in "automatic" railway brake apparatus or in the detached parts thereof which the said George Westinghouse, Jr., may hereafter take out, and also a right or license restricted in its extent and exercise by the limitations hereinafter expressed and subject to the terms and conditions hereinafter named, to make sales to railway companies of the apparatus so made; which terms and conditions to the right of sale are as follows:

1st. That the said company, its successors, legal representatives or assigns, shall not make or attempt to make nor cause to be made any sale or offer of sale of any railway brake apparatus adapted or designed for use or actually used by the actual or pretended purchaser thereof for passenger locomotive or car service embodying

the "automatic" system of construction and operation or any material part of such system; at less than the present schedule prices for the same in sets, or the present price-book prices for patented parts of sets without the consent of the said George Westinghouse, Jr.

2d. That the said company shall not knowingly sell detached parts to be afterwards made up into sets, except at schedule prices for sets, nor allow the same to be done if, in its power to prevent, nor shall any rebates, reductions, drawbacks or long time
776 without interest be allowed, such as to reduce the net schedule prices above referred to, except by consent of the said George Westinghouse, Jr.

3d. In case the said The Westinghouse Air Brake Company should at any time make or attempt to make any sale in violation of or contrary to any of the limitations on which this license is granted, then the foregoing grant of license shall thereupon be forfeited, cease and determine, and every right and license herein shall revert to and be reinvested in the said George Westinghouse, Jr., and no right of use whatever or license to use under any of said patents shall accompany or go with any apparatus so sold or attempted to be sold, nor shall the said company its successors, legal representatives or assigns have any authority to grant any right of use or license to use any such apparatus so sold or attempted to be sold in violation of any of the limitations above set forth, but the said George Westinghouse, Jr., hereby reserves and shall have the right as regards any such apparatus to proceed by suit in his own name against the pretended purchasers or actual users of the same, to enjoy any use of the same, or any sale thereof, as well as to collect gains, profits and damages resulting therefrom or caused thereby; and the legal title to said patents and the control of the same, except as above granted, is hereby reserved and retained by the said George Westinghouse, Jr., but it is agreed that the selling price of detached patented parts of the said apparatus, when sold as repair goods only, may be varied from the price now fixed according as, but only as the cost of labor and material required in their manufacture may vary, and in the same relative proportion.

And for the consideration aforesaid, the said Westinghouse hereby covenants and agrees that he will when requested so to do, unite with the said company in granting a license to each one or any of the said company's vendees, authorizing such vendee to use in the manner set forth, and to the extent set forth in said companies present printed form of agreement between itself and its vendees, and not otherwise, such or so many sets of said "automatic" apparatus either as now made or as may be hereafter improved, as such vendee may purchase from said company and pay
for at the full schedule rates already referred to.

777 In consideration of the foregoing license, the said The Westinghouse Air Brake Company hereby covenants and agrees that it will comply with, abide by, be bound by, maintain and observe each and every of the provisions of the terms, conditions and limitations hereinbefore expressed.

And for the consideration aforesaid, it is hereby mutually agreed

that in case of the insolvency, bankruptcy or dissolution of the said The Westinghouse Air Brake Company, or in case the said company should cease to manufacture the said apparatus so as to supply the demand therefor, then in any such case, the foregoing grant of license shall thereupon cease and determine, and all rights and license hereinbefore granted, shall at once revert to and be revested in the said George Westinghouse, Jr., his heirs, legal representatives and assigns.

And for the considerations aforesaid, it is hereby mutually agreed that the term "passenger-locomotive and passenger car-service" as used herein, shall be construed as including all locomotives employed wholly or in part in making up, switching and moving passenger cars, either separately or in trains, and also as including all cars, passenger, mail, baggage, express and other cars used or run as a part of a passenger train, and the said company may under the foregoing license, and subject to each and every of the terms, conditions and limitations, make sales of the "automatic" brake apparatus above referred to, for freight and construction train use, provided such sales are made at prices hereinbefore required on sales for passenger-locomotive and passenger-car use.

And for the considerations aforesaid it is also mutually agreed that the necessary and proper expenses of the making and perfecting of further improvements in automatic railway brake to be carried on by the said George Westinghouse, Jr., hereafter, in like manner as heretofore, shall be paid by the said The Westinghouse Air Brake Company, as also the fees, costs, and expenses of patenting the same in the United States.

All the foregoing covenants and agreements on the part of said George Westinghouse, Jr., are and shall be binding on his heirs, legal representatives and assigns.

778 Witness the hand and seal of the said George Westinghouse, Jr., and the corporate seal (duly attested) of the said The Westinghouse Air Brake Company, the day and year first above written.

GEORGE WESTINGHOUSE, JR. [SEAL]
THE WESTINGHOUSE AIR BRAKE
COMPANY.

ROBT PITCAIRN, *Vice-Pres't.*
W. W. CARD, *Sec'y.*

Attest:

T. W. WELSH.
RALPH BAGALEY.
WM. O. N. SCULLY.
H. H. WESTINGHOUSE.

[CORPORATE SEAL.]

Recorded Feb. 7, 1881. Ex'd: E. L. L.; M. F. M.

COMPLAINANTS EXHIBIT "LICENSE NO. 2."

Filed July 10, 1893.

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE.

To all persons to whom these presents shall come, Greeting:

This is to certify, that the annexed is a true copy from the records of this office of an instrument of writing executed by George Westinghouse, Jr., November 7, 1890, and recorded in Liber L 43, page 49.

Said record has been carefully compared with the original and is a correct transcript of the whole thereof.

In testimony whereof, I, W. E. Simonds, Commissioner of Patents, have caused the seal of the Patent Office to be [SEAL.] affixed, this fourth day of August, in the year of our Lord one thousand eight hundred and ninety-one, and of the Independence of the United States the one hundred and sixteenth.

W. E. SIMONDS,
Commissioner.

779 Whereas, George Westinghouse, Jr., of Pittsburg, Allegheny county, Pennsylvania, has procured certain letters patents of the United States, numbered, dated and entitled as follows:

Erased before signing. G.W., Jr., G. H. C. [No. 225,898, March 23d, 1880, for fluid-pressure regulator.]*

No. 235,922, December 28th, 1880, for fluid-pressure brake.

No. 236,388, January 4th, 1881, for pipe coupling.

No. 240,062, April 12th, 1881, for fluid-pressure regulator for automatic brakes.

No. 243,415, June 28th, 1881, for air-brake apparatus.

No. 243,417, June 28th, 1881, for fluid-pressure brake.

No. 243,822, July 5th, 1881, for compound hose coupling.

No. 245,109, August 2d, 1881, for air-brake strainer attachment.

No. 249,128, November 1st, 1881, for pipe coupling for pneumatic railway brakes.

No. 251,490, December 27th, 1881, for valve arrangement for pneumatic railway brakes.

No. 251,980, January 3d, 1882, for regulating valve for railway brakes.

No. 270,528, January 9th, 1883, for air-brake-pressure regulator.

No. 280,269, June 26th, 1883, for fluid-pressure regulator.

No. 288,388, November 13th, 1883, for connection for railway brakes.

No. 300,543, June 17th, 1884, for apparatus for relieving pressure in brake-cylinders.

[* Words and figures enclosed in brackets erased in copy.]

No. 345,820, July 20th, 1886, for automatic brake-regulator.

No. 360,070, March 29th, 1887, for fluid-pressure automatic brake mechanism.

No. 376,837, January 24th, 1888, for fluid-pressure automatic brake mechanism.

No. 401,915, April 23d, 1889, for automatic pump-governor for brake mechanisms.

No. 425,059, April 8th, 1890, for fluid-pressure automatic brake mechanism.

No. 432,715, July 22d, 1890, for brake-cylinder head.

780 And whereas, in and by certain articles of agreement

herein called agreement No. 1, bearing date the 22d day of November, 1880, and recorded in the U. S. Patent Office in Liber Q 26, page 36, of Transfers of Patents, the said George Westinghouse, Jr., *inter alia*, granted and assigned to the Westinghouse Air Brake Company, an exclusive license under certain patents therein recited, to manufacture automatic brake apparatus suitable for passenger-locomotive and passenger-car service, and also, a right to license to sell the same, such license to sell, however, being made subject to certain terms, conditions and limitations, all as therein set forth.

And whereas by the said agreement No. 1, and for the consideration therein set forth, the said The Westinghouse Air Brake Company is entitled to the same rights in and under each of the patents hereinbefore recited, subject only to the same terms, conditions and limitations.

Now these presents witness that for the considerations referred to in the premises, and in further consideration of the sum of one dollar to me in hand paid by the said The Westinghouse Air Brake Company, and for other good and valuable considerations me thereunto moving, I, the said George Westinghouse, Jr., have given and granted and do hereby give and grant to the said The Westinghouse Air Brake Company, of Pittsburg, Pennsylvania, its successors and assigns, the same exclusive right and license under each and all of the patents hereinbefore recited, as is granted in and by the said agreement No. 1 under the patents therein recited, to manufacture automatic brake apparatus suitable for passenger-locomotive and passenger-car service, throughout the whole United States and the territories thereof, to the full end and expiration of the respective terms of the patents hereinbefore recited, and also a right and license to sell to railway companies the apparatus so made, but this right to sell is hereby expressly made subject to the same terms, conditions and limitations as are by the said agreement No. 1 imposed on the right to sell therein granted, all which terms, conditions and limitations the said company, by its acceptance hereof binds itself to keep and observe in its exercise of the rights herein granted. The same right to use is also granted, as is granted in and by said agreement

No. 1.

781 And whereas in and by certain other articles of agreement

herein called agreement No. 2, bearing date the same day, and recorded in the U. S. Patent Office in Liber Q 26, page 30, of

Transfers of Patents, the said George Westinghouse, Jr., *inter alia*, granted and assigned to the Westinghouse Air Brake Company an exclusive license under certain patents therein recited, to manufacture automatic vacuum brake apparatus and also automatic compressed-air, freight-brake apparatus, and also a right or license to sell the same, such license to sell, however, being made subject to certain terms, conditions and limitations, all as therein set forth.

And whereas by the said agreement No. 2, and for the consideration therein set forth, the said The Westinghouse Air Brake Company is entitled to the same rights in and under each of the patents hereinbefore recited, subject only to the same terms, conditions and limitations.

Now these presents further witness that for the considerations referred to in the premises, and in further consideration of the sum of one dollar to me in hand paid by the said The Westinghouse Air Brake Company, and for other good and valuable considerations me thereunto moving, I, the said George Westinghouse, Jr., have given and granted and do hereby give and grant to the said The Westinghouse Air Brake Company, its successors and assigns, the same exclusive right and license under each and all of the patents hereinbefore recited, as is granted in and by said agreement No. 2 under the patents therein recited, to manufacture automatic vacuum brake apparatus and also automatic, compressed-air, freight-brake apparatus throughout the whole United States and the territories thereof, to the full end and expiration of the respective terms of the patents hereinbefore recited, and also a right and license to sell to railway companies the apparatus so made, but this right to sell is hereby expressly made subject to the same terms, conditions and limitations as are by the said agreement No. 2 imposed on the right to sell therein granted, all which terms, conditions and limitations the said company, by its acceptance hereof, binds itself to keep and observe in its exercise of the rights last herein granted. The same right to use is also granted as is granted in and by said agreement No. 2.

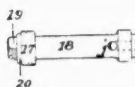
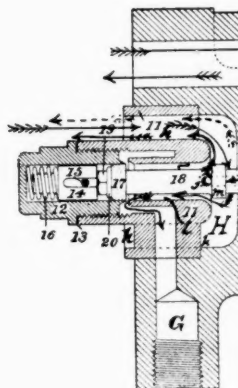
782 It is understood that since the date of said agreements

Nos. 1 and 2, certain changes have been made by agreement between the parties in the schedule prices for sets and in price-book prices for parts of sets of the said passenger-train brake apparatus, and also in the net minimum prices of sets, partial sets and detached parts of the said freight-brake apparatus, and this grant and the acceptance thereof are made with such changes in view; but as regards such prices in the future, the provisions and requirements of said agreements Nos. 1 and 2 shall continue in force.

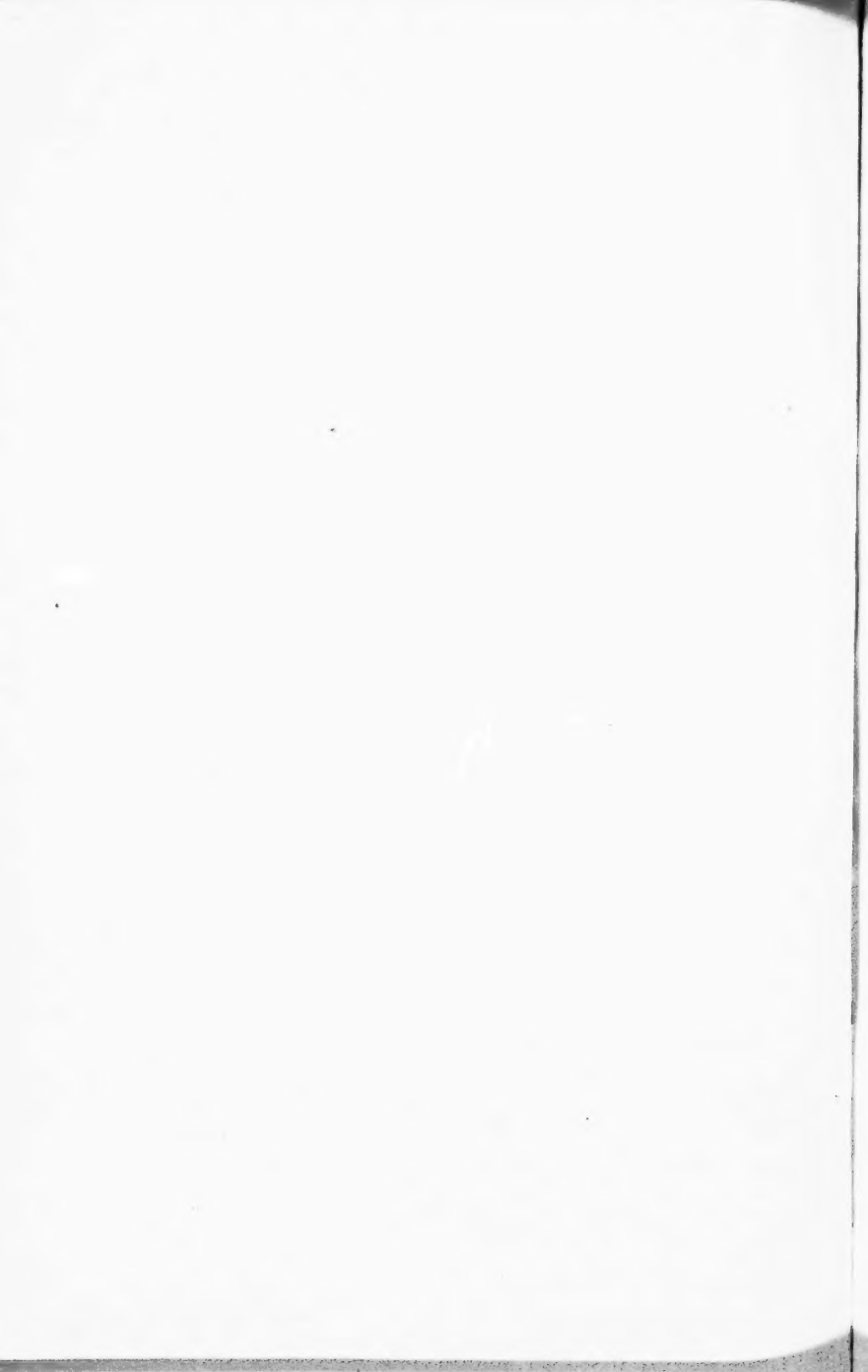
The definitions of and distinctions between "passenger-locomotive and passenger-car service," "automatic vacuum brake apparatus" and "automatic, compressed-air, freight-brake apparatus" shall herein and hereunder remain the same as in and under said agreements Nos. 1 and 2. And it is further understood and agreed that all the terms, conditions, limitations and agreements made in and by said agreement No. 1, as related to the matters therein contracted about, are hereby adopted and made a part hereof, as regards

"Compla

26 T.



This cut shows the parts of the Valve, from the body 5, as removed for cleaning.



the rights of the parties in respect of the subject-matter of automatic brake apparatus suitable for passenger-locomotive and passenger-car service, and all the terms, conditions, limitations and agreements made in and by said agreement No. 2 as related to the matters therein contracted about, are hereby adopted and made a part hereof as regards the rights of the parties in respect of automatic vacuum brake apparatus and automatic compressed-air, freight-brake apparatus, so that the matters hereof shall be as if the patents hereinbefore recited had been recited among the patents of said agreements Nos. 1 and 2, and as if also, the said agreements had been of the date hereof.

Witness the hand and the seal of the said George Westinghouse, Jr., this 7th day of November, 1890.

GEO. WESTINGHOUSE, JR. [SEAL.]

Witnesses:

GEORGE H. CHRISTY.

Recorded Nov. 10, 1890. J. F. T.; M. H.

785 Extract from "*Complainants' Exhibit Defendants' 1891 Catalogue.*"

(Pages 27, 28, and 29.)

Quick-action Brake-valve.

This valve, illustrated in plate XI, is attached to the side of the auxiliary reservoir for freight brakes, (see plate X.) and to the end of the cylinder for passenger brakes, (see plate IX.)

(Here follows diagram marked p. 784.)

The branch pipe from the train-pipe is connected to the valve by a tail piece 1 and a union nut 2 which screws on the cap 3; the intervening joint between being made tight by the washer 31. The said cap is provided with a drip-chamber E, extending below the valve mechanism, to drain the water therefrom and which is done by removing the plug 4. The cap 3 is secured to the body 5 by suitable tee-head bolts 6 and the joint between is made tight by a washer 7.

The body piece 5 is provided with a cylinder D lined with the brass bushing 8; and an opening lined with a brass bushing 9 through which the sleeve F passes; an opening lined with the brass bushing 10 which is closed by the main valve 22; and a bushing 11, in which is formed the ports of the release valve.

Threaded into the release-valve bushing 11 is the abutting cap 12 provided with a washer 13 to make a tight joint.

In the abutting cap is arranged the abutting piece 14 which has a limited movement by means of a slot and the pin 15. Against the abutting piece 14 is the abutting spring 16 which forms a resistance, in graduating, to the movement of the piston 29 and the valve parts attached thereto.

The release valve is formed by a leather cup 17 secured to the valve stem 18 by a screw 19 which extends into the stem and a washer 20 that binds the cup.

The valve stem 18 has a passage with two ports which forms the graduating valve and is secured to the piston sleeve F by a screw 21. The valve stem moves through the main valve 22 which seats on the packing rings 23 and 24. Intervening between the 786 valve stem 18 and the piston sleeve F is the sleeve cap 25 which is also secured to the sleeve by the screw 21 which has each end resting in the piston sleeve F. In the piston sleeve F is arranged the check-valve 26 which is held to its seat by the check-valve spring 27, the seat of the check-valve being formed by the packing ring 28. Integral with the sleeve F is the piston 29, provided with a packing ring 30, and moves in the cylinder D according to the variations and the direction of the air pressure.

The operation is as follows:

To charge the auxiliary reservoir, the air from the train-pipe passes in through the cap 3 and moves the piston 29 to the position shown in plate XI; the air then opens the check-valve 26 and passes through the square openings in the sleeve F to the central chamber C from which it passes through the small port B into the cylinder D, which contains the piston 29, from thence it passes through the large passage A, to the auxiliary reservoir.

To apply the brakes by graduation, a slight reduction of pressure in the train-pipe moves the piston 29 and its attached parts until the shoulder on the stem 18 comes against the main valve 22, (the main valve remaining immovable on its seat owing to the pressure in the central chamber C holding it thereon); this movement draws the stem 18 through the main valve 22 sufficiently far to expose one port in the valve-stem 18 to the air pressure in the chamber C. The air then passes from the auxiliary reservoir by way of the passage A across the cylinder D, through the port B into the central chamber C, and then through the ports in the valve-stem 18 and the port in the bushing 11 to the brake-cylinder. The piston and its attached parts remain in the said position until the pressure has been sufficiently reduced in the reservoir, by passing into the brake-cylinder, to cause the piston 29 to move to the left until the end of the valve stem 18 comes in contact with the abutting piece 14 which retards the movement; when in this position the supply port in the valve stem 18 has passed into the main valve 22, which prevents any further accumulation of pressure in the brake-cylinder; while in this position the cup 17, which controls the release 787 of the air, has not moved sufficiently far to uncover the diagonal port that leads to the atmosphere, thereby holding the pressure in the brake-cylinder and exerting the desired braking force. If it is desired to increase the pressure in the brake-cylinder the above operation is repeated.

To release the brakes the maximum pressure is restored in the train-pipe which acting on the piston 29 overcomes the resistance of the spring 16, causing the piston and its attached parts to move to the position shown in plate XI which causes the release-valve

cup 17 to uncover the diagonal port and allows the air to pass from the brake-cylinder back through the bushing 11, around the stem 18, through the port uncovered by the cup 17 and from thence to the annular chamber made in the bushing 11, from which it passes through the port G to the atmosphere, the said port being threaded to receive a pipe leading to the retarding valve.

To apply the brakes fully (*not a quick action*) an amount of air is allowed to escape gradually from the train-pipe that will move the piston 29 to unseat the main valve 22 and allow air to pass from the auxiliary reservoir to the brake-cylinder through the same ports as when graduating, and in addition through that one opened by the main valve 22.

To apply the brakes fully (*by a quick action for an emergency stop*), the train-pipe pressure is suddenly reduced at the engineers' valve about 15 pounds, which quickly moves the piston 29 and its attached parts, their full stroke, this will unseat the main valve 22 and close the release-valve ports. The air from the train-pipe will then pass through the piston sleeve F opening the check-valve 26, and into the central chamber C, and as the main valve 22 is off its seat the air will pass directly from the train-pipe to the brake-cylinder. This operation is due to the co-action of three momentary pressures of the compressed air, which, approximately, are 70 pounds from the auxiliary reservoir acting on the left of the piston 29 holding it to the extreme right of its stroke; that on the train-pipe side of the piston being 55 pounds, due to the reduction in the train-pipe and 5 pounds in the central chamber C, due to the supply thereto

being limited through the small port B and the discharge
788 therefrom through the port opened by the main valve 22 being so much larger. The 55 pounds pressure from the train-pipe will then lift the check-valve 26 and pass through the square openings in the piston sleeve F to the central chamber C from which it passes directly into the brake-cylinder, thereby performing two functions in quick action, to wit: partially emptying the train-pipe to quicken the action of the valve on the following car, and partially charging the brake-cylinder with the train-pipe air. After the pressure in the train-pipe and the brake-cylinder have been equalized, through the port opened by the main valve 22, the air will continue to pass from the auxiliary reservoir until there is an equalization of pressure in the auxiliary reservoir and brake-cylinder.

As the graduating valve operates without moving the main valve, it produces a uniform action on the several cars of a train, thereby avoiding jerking and lurching in stopping the same.

The actions of this valve in graduating, full-service application, quick action and the release, are the same as the new Westinghouse quick-action valve, thereby producing the same results in braking, which renders cars equipped with the two valves perfectly interchangeable—the hose couplings being the same.

The passage from the train-pipe to the brake-cylinder is the feature that produces quick action and is covered by our patent of 1883, reissued 1889.

The valve consists of the following parts:

- No. 1. Tail piece.
- No. 2. Union nut.
- No. 3. Cap.
- No. 4. Plug.
- No. 5. Body piece.
- No. 6. Tee-head bolts.
- No. 7. Washer between cap and body.
- No. 8. Brass cylinder bushing.
- No. 9. Sleeve bushing.
- No. 10. Main-valve bushing.
- No. 11. Release-valve bushing.
- 789 No. 12. Abutting cap.
- No. 13. Abutting-cap washer.
- No. 14. Abutting piece.
- No. 15. Pin for abutting piece.
- No. 16. Abutting spring.
- No. 17. Leather cup.
- No. 18. Valve stem.
- No. 19. Release-valve screw.
- No. 20. Release-valve washer.
- No. 21. Sleeve screw.
- No. 22. Main valve.
- No. 23. Small packing ring for main valve.
- No. 24. Large packing ring for main valve.
- No. 25. Sleeve cap.
- No. 26. Check-valve.
- No. 27. Check-valve spring.
- No. 28. Check-valve packing ring.
- No. 29. Piston and sleeve.
- No. 30. Piston packing ring.
- No. 31. Union washer.
- No. 32. Washer between the valve and auxiliary reservoir (not shown in cut).

When ordering a special part the designating numbers should be given.

Extract from "Complainants' Exhibit Defendants' 1889 Catalogue."

(Pages 23 and 24.)

Quick-action Brake-valve.

Plate IX is a sectional view of the quick-action brake-valve in which the details are plainly shown. This valve is operated by variations of pressure in the train brake-pipe whereby the air-pressure from the brake-pipe and from the auxiliary reservoir will be admitted to the brake-cylinder and the brakes applied with any desired force, and whereby the air-pressure in the brake-cylinder will be exhausted, the brakes released and the auxiliary reservoir again charged with compressed air.

The following description, with the aid of the cut will make the operation of the various parts clearly understood :

The valve is bolted to the inner head of the brake-cylinder by the flange 4, the projecting part of the head 3 extending through the cylinder head whereby the ports *a-a*, formed in the cap 21, will permit the escape of air from the interior of the brake-cylinder to the atmosphere when the release valve 17 is raised from its seat. The port *b*, which is formed in the body 1 of the valve, is connected directly with the auxiliary reservoir and provides communication therefrom to the inner surface of the piston 5 that moves in the cylinder *c*. The outer head 2 of the valve is connected by the union 22 with the train brake-pipe, so that the pressure therein will act upon the outer surface of the piston 5 and tend to move it to and hold it in the position shown in the cut.

When air pressure is admitted to the train brake-pipe to charge the auxiliary reservoir and prepare the brakes for action, this pressure will cause the piston 5 to move inward to the position shown in the cut and, in consequence of the unbalanced pressure on this side of the piston, the air will pass through the check-valve 9 therein and into the chamber *d*, whence it will pass through the port *e* to the cylinder space on the inner side of the piston 5 and then through the port *b* to the auxiliary reservoir; the air will continue to flow through these ports until the pressure in the auxiliary reservoir is equal to that in the train brake-pipe, when the check-valve 9, in consequence of the pressure exerted thereon by the spring 12, will be closed and thus communication shut off.

When it is desired to gradually apply the brakes, the pressure in the train brake-pipe will be reduced from 3 to 5 pounds, which will make an unbalanced pressure upon the piston 5 and cause it to move outward by the pressure on the inner side thereof from the auxiliary reservoir. This reduction of pressure will cause the piston 5 to move outward to such distance that the release valve 17 will be brought against its seat by the tension of its spring 20, and

791 thus close communication between the brake-cylinder and the port *f* that opens to the atmosphere; the further movement of the piston 5 will cause the graduating valve 13 to be raised from its seat and the air pressure in the chamber *d* will flow past the graduating valve into the chamber *g*, and thence through the ports *h*, with which the cap 3 is provided, into the brake-cylinder, and moves the brake-cylinder piston outward and applies the brake; the piston 5 then moves slightly inward again, and closes the graduating valve 13 when the pressure in the chamber *d* has been sufficiently reduced, thus closing all communication with the brake-cylinder and by the pressure confined therein maintain a constant and uniform pressure upon the brakes, which pressure, if desired, can be further increased by a greater reduction of the air pressure in the train brake-pipe and the admission of more air to the brake-cylinder, in the manner described.

When it is desired to release the brakes, the air pressure is again restored in the train brake-pipe which will cause the piston 5 to move to its inward position and raise the release valve 17 from its

seat, thereby permitting the air to escape from the brake-cylinder through the port *f* to the atmosphere; the air pressure from the train brake-pipe will pass through the check-valve 9 and again charge the auxiliary reservoir for future use.

When the train brakes are to be applied quickly and with full force, the pressure will be suddenly reduced in the train brake-pipe about 10 or 15 pounds, which will cause the piston 5 to be moved immediately to its extreme outward position, the release valve 17 is then brought against its seat and the plug that is integral with the piston 5 wholly withdrawn from its cylinder 16, thus presenting the full area of the latter to the flow of the air pressure from the chamber *d* to the brake-cylinder; the releasing of pressure in the chamber *d* will permit the air to escape from the brake-pipe through the check-valve 9, thereby instantly reducing the air pressure in the train brake-pipe and produce a simultaneous action of all the brakes on the train.

It will be seen this valve allows compressed air to pass to the brake-cylinder direct from both the brake-pipe and the auxiliary reservoir, which quickly applies the brakes and produces the simultaneous action on long trains.

The valve consists of the following parts:

- No. 1. Body.
- No. 2. Outer head.
- No. 3. Inner head.
- No. 5. Piston.
- No. 6. Piston packing ring.
- No. 7. Cylinder lining.
- No. 8. Check-valve chamber.
- No. 9. Check-valve.
- No. 10. Check-valve packing.
- No. 11. Check-valve follower.
- No. 12. Check-valve spring.
- No. 13. Graduating valve.
- No. 14. Graduating-valve chamber.
- No. 15. Plug packing.
- No. 16. Plug cylinder.
- No. 17. Release-valve stem.
- No. 18. Release valve.
- No. 19. Release-valve packing.
- No. 20. Release-valve spring.
- No. 21. Cap.

In ordering a special part the designating number should be given.

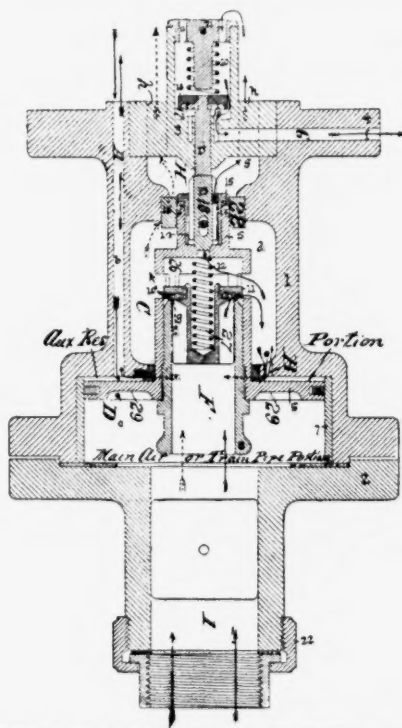
(Here follows diagram marked p. 793.)

Illustration from
"Complainants' Exhibit, Defendants'
1889 Catalogue."

BOYDEN POWER BRAKE COMPANY

Plate IX.

QUICK-ACTION BRAKE-VALVE.



795 United States Circuit Court for the District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WEST-
INGHOUSE AIR BRAKE COMPANY

VERSUS

BOYDEN POWER BRAKE COMPANY; GEORGE
A. Boyden, President; Charles B. Mann, Sec-
retary, and Wm. Whitridge, Treasurer.

In Equity. No. 321.

Depositions of witnesses and other evidence on behalf of defendants in the above-entitled cause, before George Morris Bond, a commissioner appointed by the circuit court of the United States for the fourth circuit, in and for the Maryland district, at room 546 Equitable building, in the city of Baltimore, commencing at 10.30 a. m., on Wednesday, April 26th, 1893.

Present: J. Snowden Bell, Esq., of counsel for complainants, and Lysander Hill, and Charles B. Mann, Esqs., of counsel for defendants.

Defendants' counsel offers in evidence the following exhibits, to wit:

A section of a triple valve and its casing to be marked "Defendants' Exhibit Section of Westinghouse Triple Valve of Patent No. 360,070 (Red Valve)."

Also a copy, certified by the Commissioner of Patents, of the file-wrapper and its contents in the matter of the application for letters patent granted to George Westinghouse, Jr., March 29, 1887, No.

360,070, for improvement in fluid-pressure automatic brake
796 mechanism: the same to be marked "Defendants' Exhibit Copy of Westinghouse File-wrapper, and Contents."

Also a bound package or book containing copies of specifications and drawings of patents: the same to be marked "Defendants' Exhibit Brake Patents." This exhibit contains copies of the following patents, to wit:

Geo. Westinghouse, Jr., No. 88,929, Ap'l 13, 1869.

Geo. Westinghouse, Jr., No. 124,404, M'ch 5, 1872.

Geo. Westinghouse, Jr., No. 144,006, Oct. 28, 1873.

Geo. Westinghouse, Jr., No. 168,359, Oct. 5, 1875.

Geo. Westinghouse, Jr., No. 217,838, July 22, 1879.

Geo. Westinghouse, Jr., No. 220,556, Oct. 14, 1879.

Geo. A. Boyden, No. 280,285, June 26, 1883.

Geo. Westinghouse, Jr., No. 360,070, M'ch 29, 1887.

Geo. Westinghouse, Jr., No. 376,837, July 24, 1888.

Geo. A. Boyden, No. 481,134, Aug. 16, 1892.

Geo. A. Boyden, No. 481,135, Aug. 16, 1892.

Geo. A. Boyden, No. 481,136, Aug. 16, 1892.

Also, a section of a triple valve and its casing, to be marked "Defendants' Exhibit Section of Defendants' Triple Valve, Plate XI, 1891 Catalogue."

Also, a drawing of said triple valve, to be marked "Defendants'

Exhibit Drawing of Triple Valve, Plate XI, Defendants' 1891 Catalogue."

Also, a triple valve and casing with a glass window in its side, the same being one of defendants' triple valves in a casing having a window for observing its action; to be marked "Defendants' Exhibit A."

Also, another triple valve and casing, to be marked "Defendants' Exhibit B;" the same being defendants' triple-valve piston and casing with Westinghouse main and graduating valves, and with observation window.

Also, the section of a structure similar to that of Defendants' Exhibit B, to show the internal construction of the parts; the same to be marked "Defendants' Exhibit C."

Also, a package containing ten printed illustrated drawings, to be marked "Defendants' Exhibit Illustrative Cuts," Nos. 1 to 10 inclusive.

797 GEORGE A. BOYDEN, a witness produced on behalf of the defendants, having been duly sworn, deposes in answer to interrogatories, and says as follows:

1 Q. State your name, age, residence and occupation?

A. George A. Boyden, I am 37 years old, of Baltimore city. I am a mechanical engineer and at present the president of the Boyden Brake Company.

2 Q. How long have you been engaged in mechanical pursuits and to what extent?

A. About sixteen years,—the first ten years in designing and constructing various kinds of machinery,—the last seven exclusively in designing and constructing air brakes and their adjuncts.

3 Q. Are you the George A. Boyden to whom were granted the several Boyden patents for air brakes shown in the exhibits offered in evidence this morning, and purporting to have been granted to George A. Boyden, of Baltimore?

A. I am.

4 Q. Are you familiar with the construction and mode of operation of the triple valve offered in evidence this morning as "Defendants' Exhibit Section of Westinghouse Triple Valve of Patent No. 360,070"?

A. I am.

5 Q. Do you understand the construction and operation of the four exhibits offered in evidence this morning and respectively marked as follows, to wit: "Defendants' Exhibit Section of Defendants' Triple Valve, Plate XI, 1891 Catalogue;" "Defendants' Exhibit A;" "Defendants' Exhibit B;" and "Defendants' Exhibit C"?

A. I do.

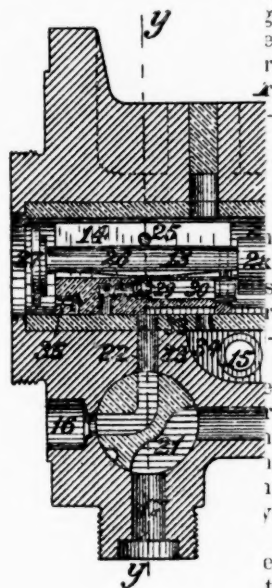
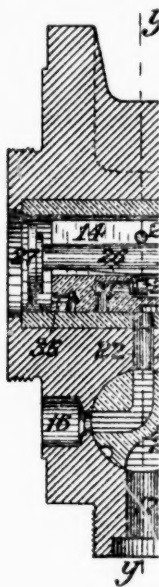
6 Q. Will you please describe the construction and operation of the Westinghouse quick-action triple valve shown in "Defendants' Exhibit Section of Westinghouse Triple Valve of Patent No. 360,070 [red valve]"?

PHC

PHOTO-E

Corr

Complain



A. This is a valve mechanism used in automatic air brakes, the functions of which are: 1st. To admit air from the main air
 798 pipe to the auxiliary reservoir, through the valve port or feeding-in groove 51, shown in Fig. 2 of complainants' patent No. 360,070. 2nd. To admit air from the auxiliary reservoir to the brake-cylinder through the port controlled by the graduating valve 29, by the preliminary movement of the piston 12. 3d. To admit auxiliary reservoir air to the brake-cylinder through the valve-port 35 by the final movement of the piston. 4th. To exhaust air from the brake-cylinder to the atmosphere through the valve-cavity 33. These four valves form what is commonly known as a "triple valve" proper, as used in the art prior to 1887. The operation of this triple valve is as follows: The air from the main air pipe passes to the auxiliary reservoir and charges it ready for use. When it is desired to apply the brakes with partial pressure by the preliminary movement of the piston 12, an amount of air is discharged from the main air pipe which by the consequent reduction of pressure, moves the piston 12 in the direction of the main air pipe, commonly called the "train-pipe," thereby closing the exhaust valve 33 and bringing the port 31 coincident with the passage to the brake-cylinder, at the same time unseating the graduating valve 29 and permitting air thereby to pass from the auxiliary reservoir to the brake-cylinder and apply the brakes with any desired amount of auxiliary reservoir pressure.

(Here follow diagrams marked pp. 799 & 800.)

To release the brakes, the maximum pressure is re-established in the main air pipe, which moves the piston and the valve parts back to the position shown in figure 2 of patent No. 360,070. This brings the exhaust port 33 into communication with the brake-cylinder and atmosphere, and thereby exhausts the pressure from the brake-cylinder and releases the brakes.

To apply the brakes fully with the auxiliary reservoir pressure by the final movement of the piston 12, a sufficient amount of air is gradually exhausted from the main air pipe to move the piston
 801 its full stroke. This will bring the valve port 35 coincident with the passage 22 and thereby establish communication from the auxiliary reservoir to the brake-cylinder and fully apply the brakes with the reservoir pressure.

The brakes are released as before stated, by re-establishing the maximum pressure in the main air pipe. The operations just described are those of the "triple valve," *per se*, and are such as were used prior to 1887.

With this triple-valve mechanism is arranged and combined an "auxiliary valve," 41, shown in figure 2 of patent No. 360,070. This valve performs no functions of the triple-valve proper, but is used to perform another function, which is, admitting main air-pipe pressure directly to the brake-cylinder through passages which are independent of the triple-valve mechanism.

This valve is actuated by the piston 12 of the triple valve, and,

when open, under certain conditions, the main air-pipe pressure directly enters the brake-cylinder, thereby depleting the train-pipe pressure to a certain extent, which depletion quickens the action of the triple valves on the succeeding cars.

The essential features of the device are: 1st, the *triple valve proper*, containing sufficient valves to make it perform the triple-valve functions, and 2nd, an "*additional or auxiliary valve*," to admit the main air-pipe pressure directly to the brake-cylinder.

In the above answer, I have used the numerals of the Westinghouse patent No. 360,070, to designate the parts referred to in the exhibit. Figure 2 of said patent being the one referred to.

7 Q. Please describe the construction and operation of the defendants' quick-action triple valve in the form of its embodiment shown in "Defendants' Exhibit Section of Defendants' Triple Valve, Plate XI, 1891 Catalogue," and in "Defendants' Exhibit A."

Recess.

A. In answering this question I will use the reference letters shown in "Defendants' Exhibit Drawing of Triple Valve of Plate XI, Defendants' 1891 Catalogue."

I invented this valve device, and it is the outcome of a
802 prior invention of mine, which was patented June 26th, 1883,
No. 280,285. This valve mechanism is used in automatic

air brakes, the functions of which are: 1st. To admit air from the main air pipe to the auxiliary reservoir. (The course of this air is through the port controlled by the check-valve 26 into the chamber C, through passages B and A to the auxiliary reservoir.) 2nd. To admit air from the auxiliary reservoir to the brake-cylinder through the graduating valve port 40, by the preliminary movement of the piston 29. 3d. To admit auxiliary reservoir air to the brake-cylinder through the port uncovered by the main valve 22, by the final movement of piston 29. 4th. To exhaust air from the brake-cylinder to the atmosphere, through the port J uncovered by the valve 17.

(Here follows diagram marked pp. 803 & 804.)

These four valves form what is commonly known as a "triple valve," as is used in the art prior to 1887. The operation of this valve mechanism is as follows: The air from the main air pipe passes to the auxiliary reservoir through the port controlled by the check-valve 26, and through the passages B and A.

When it is desired to apply the brakes with partial pressure by the preliminary movement of piston 29, air is discharged from the main air pipe, which moves the piston 29 in the direction of the train-pipe sufficiently far to close the exhaust valve 17, and withdraw the valve port 40 from the valve 22, thereby permitting auxiliary reservoir air to pass to the brake-cylinder through the graduating valve port 40, and apply the brakes with the desired degree of pressure.

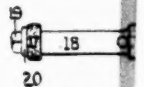
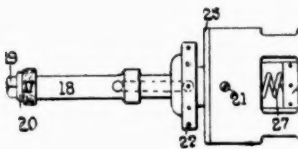
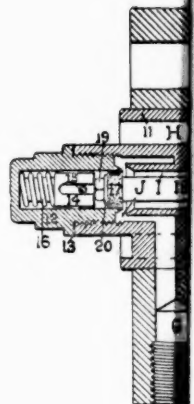
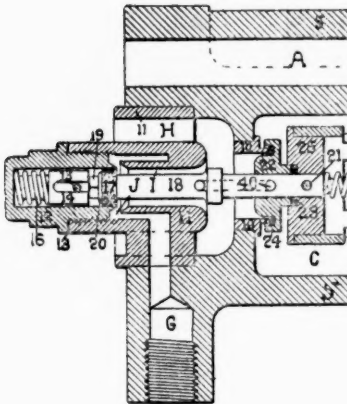
To release the brakes, the maximum pressure is restored in the

PHOTO-EN
 " DEFENDANT'S EXHIB
 PLATE XI, DEFEN

P
 " DEFENDANT
 PLATE XI

Defendant's Q

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train-pipe, which shifts the valve mechanism to the position shown in the drawing named in the question, thereby uncovering the port J and *and* permitting the air in the brake-cylinders to exhaust to the atmosphere.

To apply the brakes fully with the auxiliary reservoir pressure by the final movement of the piston, sufficient pressure is gradually exhausted from the main air pipe to move the piston
 805 its full stroke. This will unseat the main valve 22 and thereby establish full communication between the auxiliary reservoir and brake-cylinder and apply the brakes with the full auxiliary reservoir pressure.

The operations just described are those of the "triple valve," *per se*, and are such as are used in the art prior to 1887.

With this triple-valve mechanism are combined the differential passages F, B and A, by which main air-pipe pressure is made to pass to the brake-cylinder through the triple-valve chamber C, and the port uncovered by the valve 22, which port also simultaneously admits the auxiliary reservoir pressure to the brake-cylinder. This depletion of the main air-pipe pressure quickens the action of the brakes on the succeeding cars.

The essential features of this device, to make it a quick-acting triple valve, are: 1st. *The triple valve proper*, which performs the triple-valve functions, and second, *the differential passages*, by which the triple valve is made to perform the additional function of admitting main air-pipe pressure to the brake-cylinder.

S Q. Please compare the defendants' quick-acting triple valve, which you have just described, with the triple valve of your patent dated June 26th, 1883, No. 280,285, referred to in your last answer, and explain wherein the "triple valve" of your patent No. 280,285 contained the germ or suggestion of which the defendants' quick-action triple valve was the outgrowth, as stated in your last answer.

(Objected to as irrelevant and immaterial.)

A. I wish to state here that my 1883 patent was not for a "quick-action" *valve* (as that term is now understood), but it contains two essential elements which I embodied in "defendants' quick-action triple valve."

These elements are: 1st. A passage D from the main air pipe to the triple-valve chamber, in which passage is located a check-valve. 2d. A single valve H, arranged to govern a port through which the air pressure from the main air pipe and the air pressure from the auxiliary reservoir both pass to the brake-cylinder.

806 The embodiment of these features in defendants' quick-action triple valve is obvious by comparing drawings Nos. 8 and 9 in Defendants' Exhibit Illustrative Cuts.

I may here remark that in all these ten illustrative cuts the moving parts are printed in solid black to distinguish them from the stationary parts.

In drawing No. 8 it will be observed that the air from the main air pipe (as shown by the blue line), first passes through the passage F in the piston, then through the port controlled by the check-

valve into the chamber C, from which it passes to the brake-cylinder through the port uncovered by the valve 22.

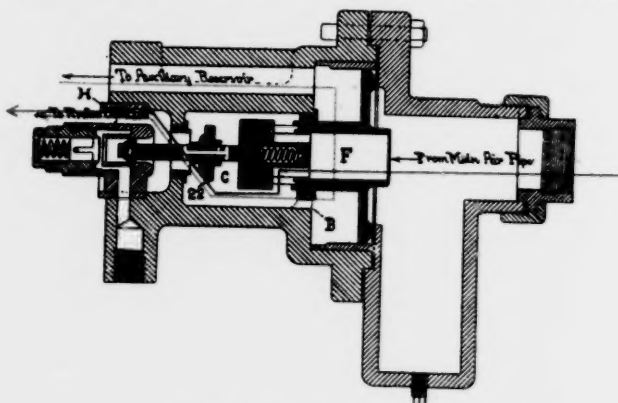
This identical feature is in my 1883 patent, as will be observed by examining drawing No. 9 of "Defendants' Exhibit Illustrative Cuts," wherein the blue line represents the passage of air from the main air pipe through the passage D in the piston, then through the check-valve port into the valve chamber, from which it passes to the brake-cylinder through the port uncovered by the valve II.

By referring to drawing No. 8, the course of the auxiliary reservoir air, in defendants' quick-action triple valve, as shown by the red lines, is from the auxiliary reservoir through the passage B into the valve chamber C, from which it passes to the brake-cylinder through the same port uncovered by the valve 22, through which also the air from the main air pipe (shown by the blue line) is admitted to the brake-cylinder. This identical feature is in my 1883 patent, as seen from drawing No. 9, in which the red line indicates the course of the air from the auxiliary reservoir through the port R¹ into the valve chamber, from which it passes to the brake-cylinder through the same port uncovered by the valve II, which admits the air from the main air pipe (as shown by the blue line).

(Here follow diagrams marked pp. 807 & 808.)

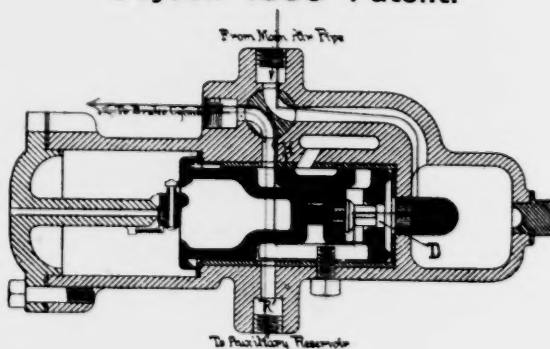
DEFENDANT'S EXHIBIT, "ILLUSTRATIVE CUTS."

Defendant's Quick Action Triple Valve.



Drawing No. 8.

Boyden 1883 Patent.



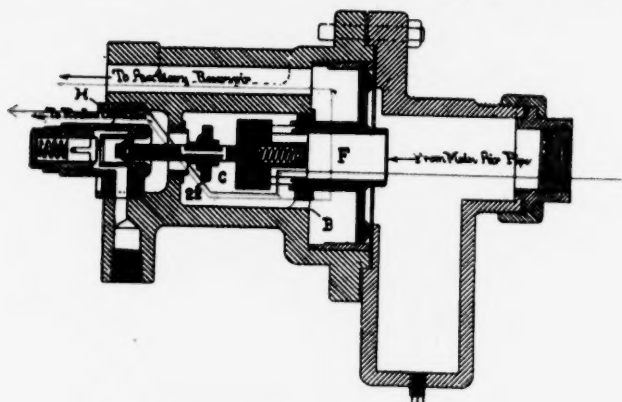
Drawing No. 9.



808

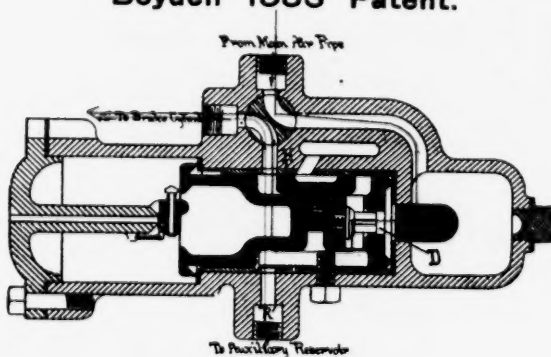
DEFENDANT'S EXHIBIT, "ILLUSTRATIVE CUTS."

Defendant's Quick Action Triple Valve.

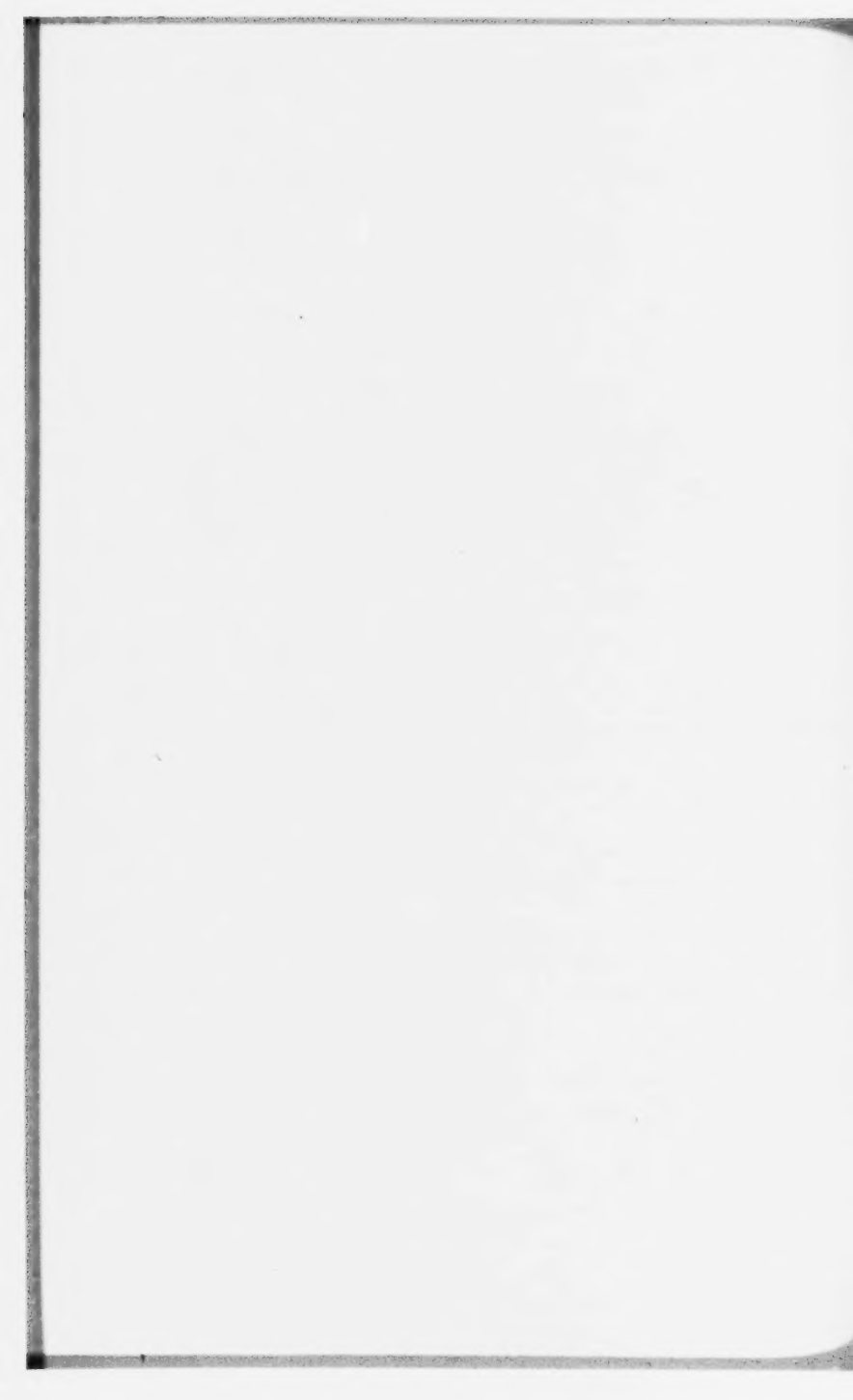


Drawing No. 8.

Boyden 1883 Patent.



Drawing No. 9.



In both devices, train-pipe air (shown by the blue line) and auxiliary reservoir air (shown by the red line), *enter the triple-valve chamber, and both pass to the brake-cylinder through the same port uncovered by one valve.*

809 Having done this in my 1833 patent, I embodied these features in the "defendants' quick-action triple-valve," to which I added differential passages, and thereby produced a quick-action valve without the aid of an *auxiliary valve*.

9 Q. Please compare defendants' quick-action triple valve (I mean the form shown in plate XI of defendants' 1891 catalogue) with the quick-action triple valve of complainants' patent, No. 360,070, here in suit, and point out their similarities and differences.

A. Defendants' quick-action triple valve and complainants' patent 360,070 are both valve mechanisms used in automatic air brakes. Each of them has four functions. 1st. Admitting air from the main air pipe to the auxiliary reservoir ready for use; 2d. Admitting air from the auxiliary reservoir to the brake-cylinder to apply the brakes; 3d. Exhausting air from the brake-cylinder to the atmosphere to release the brakes, and 4th, admitting air from the main air pipe to the brake-cylinder to deplete the train-pipe pressure, thereby quickening the action of the brakes on the succeeding cars, and also increasing the pressure in the brake-cylinder over that obtainable from the auxiliary reservoir.

In comparing the two devices I will point out each valve therein, state its functions, and compare it with the corresponding valve in the other device.

I will indicate the different courses of the air in performing the different functions by colored lines on drawings "Defendants' Exhibits Illustrative Cuts," using dotted lines where the passages do not fall on the section line on which the said cuts are made.

I will first describe those valves which form the triple valve proper in the complainants' patent No. 360,070, and as I proceed I will point out the corresponding valves in the defendants' quick-action triple valve.

S10 FIRST VALVE. *Feeding-in valve, whose function is to admit air from the main air pipe to the auxiliary reservoir.*

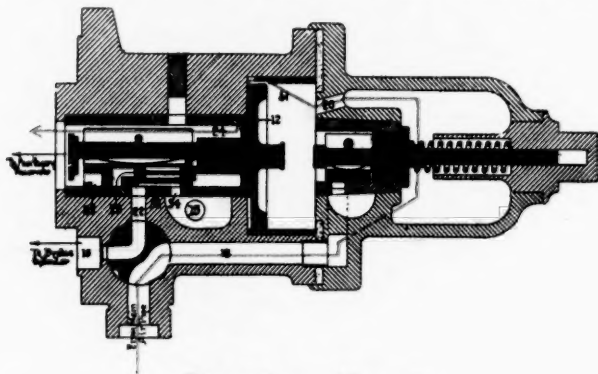
In the complainants' patent, No. 360,070, in performing the functions of charging the auxiliary reservoir the air passes from the main air pipe through the passages 17, 18 and 20, then through the feeding-in valve port 51, controlled by the piston 12, from which it passes to the auxiliary reservoir through the chamber 24.

The course of the air in performing this function is shown by a red line on cut No. 1 of the "Defendants' Exhibits Illustrative Cuts."

(Here follow diagrams marked pp. 811 and 812.)

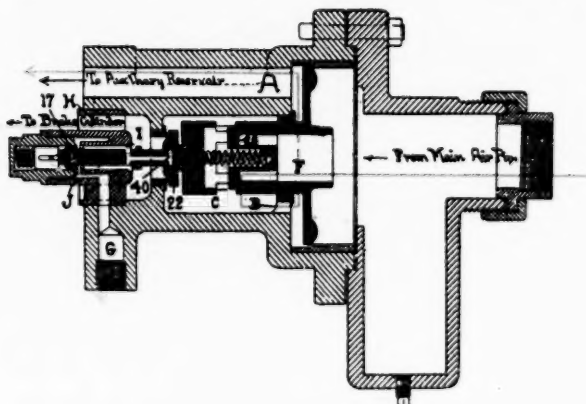
DEFENDANT'S EXHIBIT, "ILLUSTRATIVE CUTS."

Complainant's Patent No. 360,070.

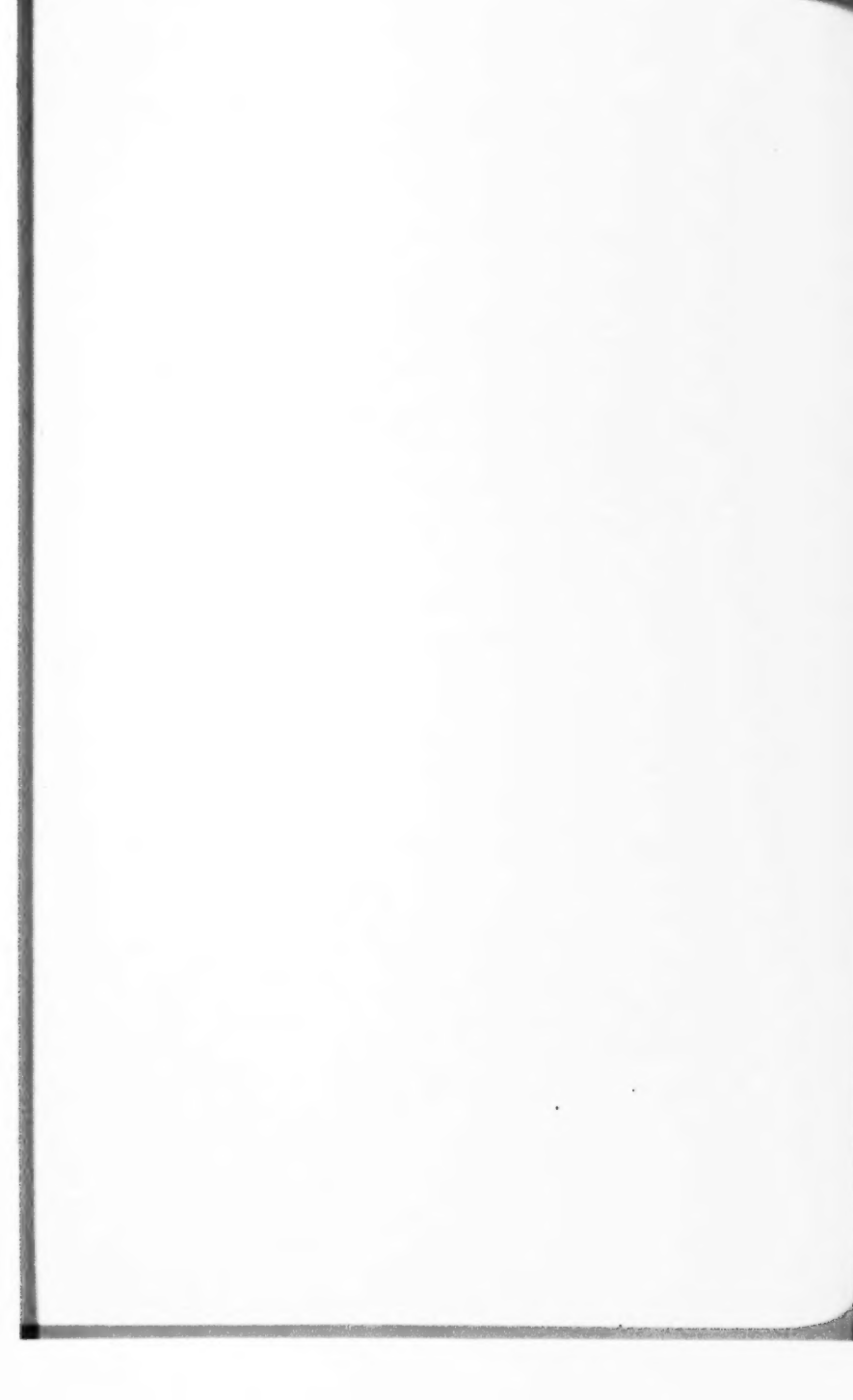


Drawing No. 1.

Defendant's Quick Action Triple Valve.

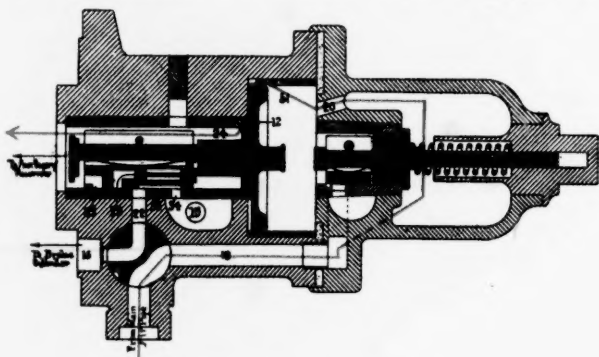


Drawing No. 2.



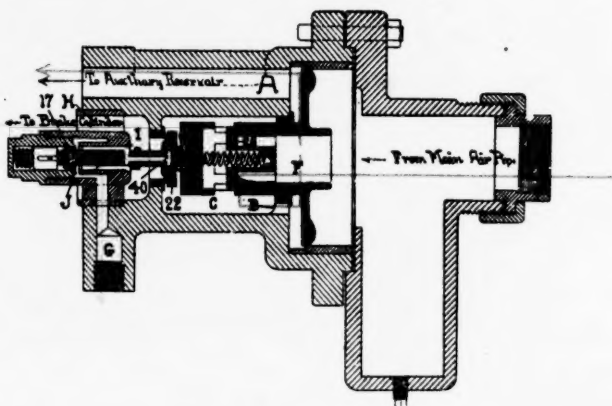
DEFENDANT'S EXHIBIT, "ILLUSTRATIVE CUTS."

Complainant's Patent No. 360,070.



Drawing No. 1.

Defendant's Quick Action Triple Valve.



Drawing No. 2.



In defendants' quick-action valve, in performing this function of charging the auxiliary reservoir, the air passes from the main air pipe through the passage F, then through the port of the check-valve 26 and passages B and A to the auxiliary reservoir.

The course of the air in performing this function is shown by a red line in defendants' quick-action triple valve on cut No. 2 of the "Defendants' Exhibits Illustrative Cuts."

Adjourned until Thursday, April 27th, 1893, at 10 o'clock a. m., at which time the testimony was resumed, the same parties and counsel being present, and the witness continued as follows:

813 SECOND VALVE. *Exhaust valve, whose function is to control the passage of air from the brake-cylinder to the atmosphere and thereby release the brakes.*

In the complainants' patent, No. 360,070, in performing the function of releasing the brakes the air passes from the brake-cylinder to the atmosphere through the passages 16, 22, valve port 33, and passages 34 and 15. The course of the air in performing this function is shown by a yellow line on cut No. 1 of illustrative cuts.

In defendants' quick-action triple valve, in performing the function of releasing the brakes, the air passes from the brake-cylinder through the passage I, then through the port J, uncovered by the valve 17, to the atmosphere through the passage G. The course of the air in performing this function is shown by a yellow line on cut No. 2.

- 814 THIRD VALVE. *Graduating valve, whose function is to perform part of the work of the main valve, i. e., that of admitting auxiliary reservoir air to the brake-cylinder to apply the brakes, but which may be actuated by a less pressure than the main valve and operated when the main valve is inactive.*

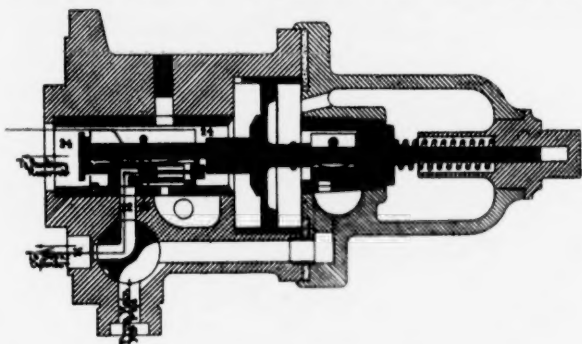
In complainants' patent, No. 360,070, in performing the above function, the air passes from the auxiliary reservoir into the valve chamber 24, then passing through the port uncovered by the graduating valve 29 to the brake-cylinder through passages 22 and 16. The course of the air in performing this function is shown by a red line on cut No. 3.

(Here follow diagrams marked pp. 815 & 816.)

In the defendants' quick-action triple valve, when performing the graduating function, the air passes through the passages A and B into the chamber C, then passes through the port 40 (forming the graduating valve) to the brake-cylinder by way of the passage H. The course of the air in performing this function is shown by a red line on cut No. 4.

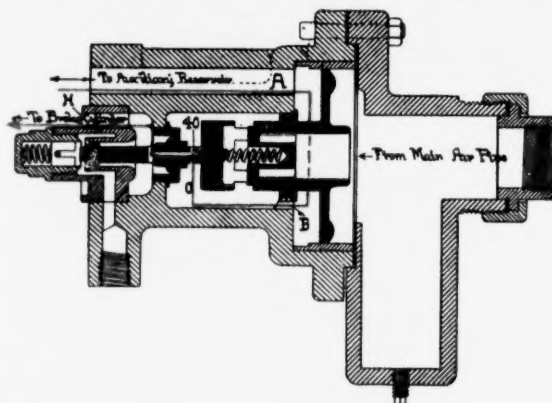
DEFENDANT'S EXHIBIT, "ILLUSTRATIVE CUTS."

Complainant's Patent No. 360,070.



Drawing No. 3.

Defendant's Quick Action Triple Valve.

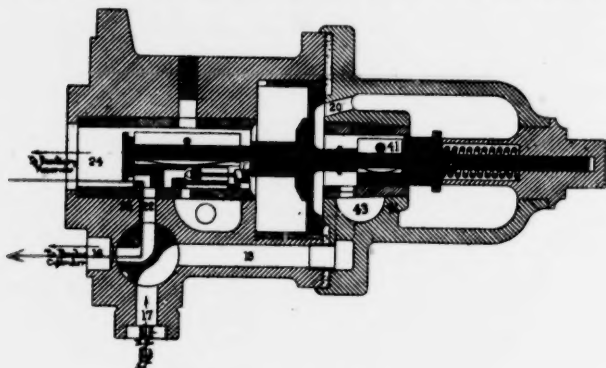


Drawing No. 4.



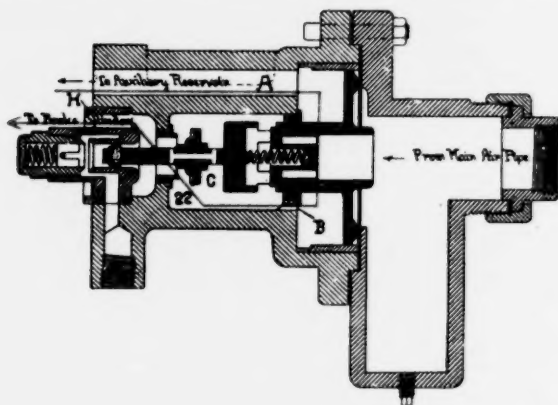
DEFENDANT'S EXHIBIT, "ILLUSTRATIVE CUTS."

Complainant's Patent No. 360,070.



Drawing No. 5.

Defendant's Quick Action Triple Valve.



Drawing No. 6.

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7 FOURTH VALVE. *Main valve, whose function is to admit air from the auxiliary reservoir to the brake-cylinder to apply the brakes, the same as the graduating valve, but requires for its actuation a greater pressure and operates when the graduating valve is inactive.*

In the complainants' patent No. 360,070, when performing the above function, the air passes from the auxiliary reservoir through the valve port 35, then to the brake-cylinder through the passages 15 and 16. The course of the air in performing this function is shown by a red line on cut No. 5.

In defendants' quick-action triple valve, when performing the above function, the air passes from the auxiliary reservoir through ports A and B into the chamber C, then passes through the port covered by the valve 22 to the brake-cylinder, through the passage H.

The course of the air in performing this function is shown by a red line on cut No. 6.

8 The four valves described above form a "triple valve" proper in both the complainants' and defendants' devices, and disregarding mere matters of form are the same as are described in a triple valve in complainants' patent No. 360,070, and the Westinghouse patent No. 220,556, dated October 14th, 1879.

In the three devices mentioned, viz: complainants' patent No. 360,070, Westinghouse patent No. 220,556 and defendants' triple-valve device, the functions of the four valves forming the "triple valve" are the same as are also the results they produce.

These valves are briefly as follows:

Complainants' patent No. 360,070.	Defendants' quick-action triple valve.
1st. Feeding-in valve 51.	1st. Feeding-in valve formed by the check-valve 26.
2d. Exhaust valve formed by the port 33.	2d. Exhaust valve formed by the valve 17.
3d. Graduating valve 29.	3d. Graduating valve formed by the port 40.
4th. Main valve formed by the port 35.	4th. Main valve formed by the valve 22.

I think the fact is obvious that if the four valves enumerated in the complainants' patent No. 360,070, form a "triple valve" proper, it follows that the four corresponding valves in the "defendants' quick-action triple valve" also form a triple valve proper, especially so as they each perform the same function, produce the same result, and operate under the same conditions.

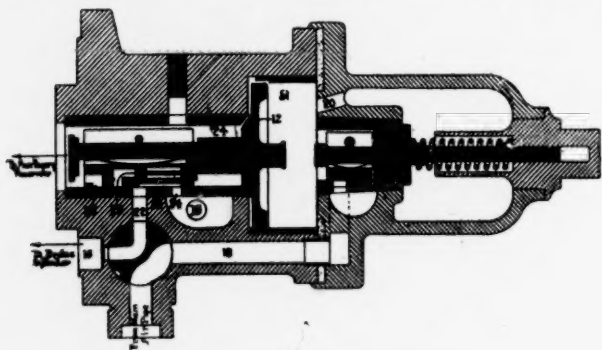
It is true, the physical structures are quite different in form, but in reality they are the same, for the reasons above given.

Having described the triple valve proper, I will now describe those parts which produce "quick action" in both complainants' and defendants' quick-action valves, using colored lines to indicate the different courses of the air, the same as when describing the triple valve.

(Here follow diagrams marked pp. 819 & 820.)

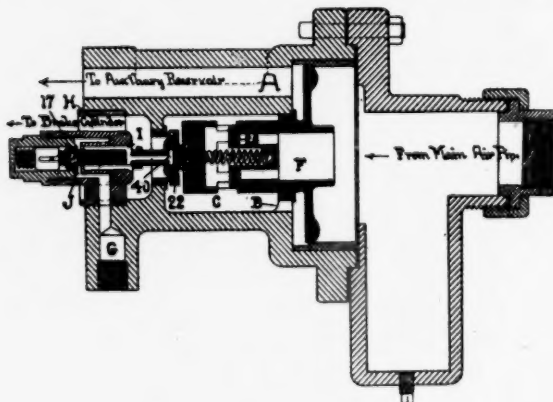
DEFENDANT'S EXHIBIT, "ILLUSTRATIVE CUTS."

Complainant's Patent No. 360,070.



Drawing No. 1.

Defendant's Quick Action Triple Valve.

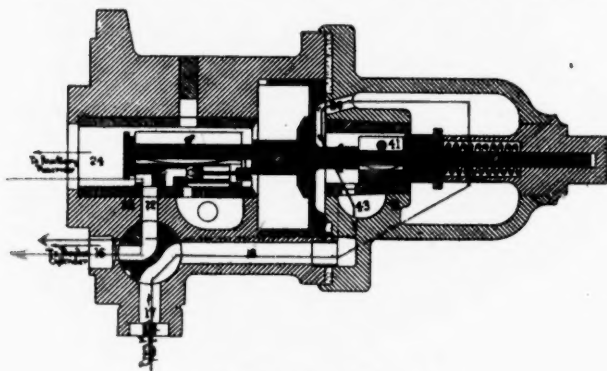


Drawing No. 2.



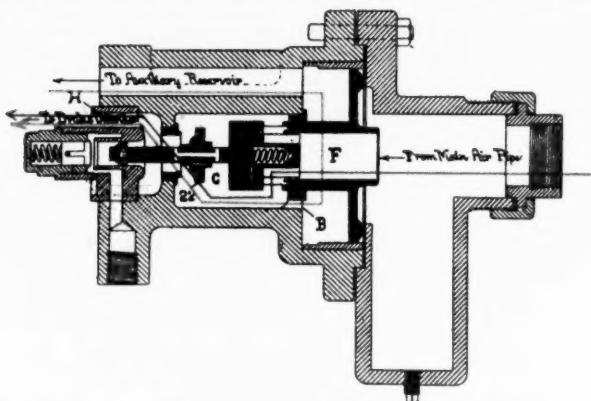
DEFENDANT'S EXHIBIT, "ILLUSTRATIVE CUTS."

Complainant's Patent No. 360,070.



Drawing No. 7.

Defendant's Quick Action Triple Valve.



Drawing No. 8.



FIFTH VALVE. *Auxiliary valve whose only function is to admit air from the main air pipe to the brake-cylinder without first passing to the auxiliary reservoir, thereby depleting the main air-pipe pressure, to quicken the action of the brakes on the succeeding cars.*

In complainants' patent No. 360,070, to perform the above function, the air from the main air pipe passes through the passages 17, 18 and 20, then through the port uncovered by the valve 41 to the brake-cylinder by way of the passage 43, which is only partially shewn, as the remaining portion falls on a plane different from that on which the drawing is made. The course of the air, in performing this function, is shown by a blue line on cut No. 7, portions of said blue line being dotted, indicating the part of passage 43 not shown.

In complainants' patent No. 360,070, to apply the brakes by a quick action, the triple valve performs its function exactly the same as previously explained by me, to which is added a fifth or auxiliary valve 41, to admit air from the main air pipe to the brake-cylinder.

The number of valves shewn and described in complainants' patent No. 360,070 to perform the "triple-valve" and "quick-action" functions are five, four of which belong to the triple valve proper, and the fifth or auxiliary valve is added to admit air from the main air pipe to the brake-cylinder. This valve is an addition to the "triple valve" and performs no function of the triple valve.

In defendants' quick-action triple valve, I do not find the fifth or auxiliary valve (to admit air from the main air pipe to the brake-cylinder), but one of the four forming the triple valve proper admits the main air-pipe air to the brake-cylinder simultaneously with the auxiliary reservoir air when producing quick action.

In defendants' quick-action triple valve, to perform the quick-action function, the air passes from the main air pipe through the passage F, through the port uncovered by the check-valve into the triple-valve chamber C, then through the port uncovered by the valve 22 of the triple valve to the brake-cylinder, through the passage H. The course of the air in performing this function is shown by a blue line on cut No. 8.

822 Now, by comparing cuts 7 and 8, the fact is apparent that in the complainants' device, of patent No. 360,070, the air from the auxiliary reservoir (shown by a red line), passes through the port 35 (which forms one of the "triple valves") to the brake-cylinder, while the air from the main air pipe (shown by a blue line) passes through a port uncovered by the auxiliary valve 41 and thence through passage 43 to the brake-cylinder. This distinctly shows that the complainants' device uses two valves to perform the

quick application of the brakes, one of which belongs to the *triple valve proper* while the other is an *auxiliary valve additional* to the triple-valve structure.

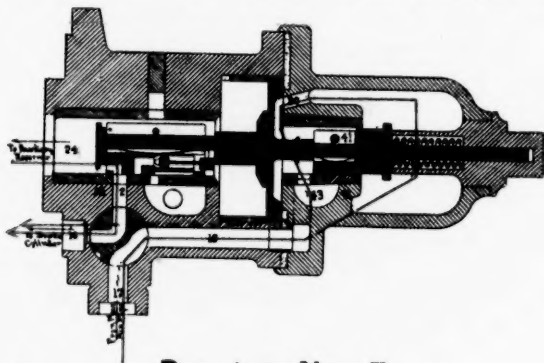
(Here follows diagram marked p. 823.)

In the defendants' quick action triple valve the air from the auxiliary reservoir (shown by a red line) passes through the port B into the chamber C, then through the *port uncovered by the valve 22* to the brake-cylinder through the passage H, while the air from the main air pipe (shown by a blue line) passes through the same *port uncovered by the valve 22*, through which the air from the auxiliary reservoir is also passing—the valve 22 performing the double function of admitting air from both the main air pipe and auxiliary reservoir simultaneously to the brake-cylinder. Therefore, the difference between complainants' device of patent No. 360,070 and the "defendants' quick-action triple valve" is—complainants' patent No. 360,070 employs an *additional valve* to admit air from the main air pipe to the brake-cylinder, and one of the triple valves to admit auxiliary reservoir air to the brake-cylinder in producing a quick application of the brakes, whereas the defendants' quick-action triple valve admits air from the main air pipe to the brake-cylinder through the *same valve* which is *simultaneously* admitting air from the *auxiliary reservoir* in producing quick application of the brake, thereby dispensing with, or not requiring, the fifth or auxiliary valve as used in the complainants' No. 360,070, to produce the said quick action of the brakes.

Recess.

DEFENDANT'S EXHIBIT, "ILLUSTRATIVE CUTS.

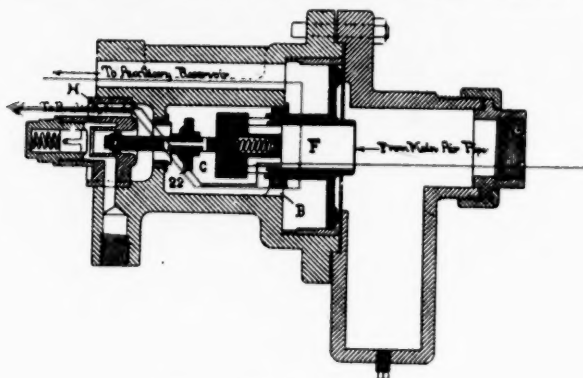
Complainant's Patent No. 360,070.



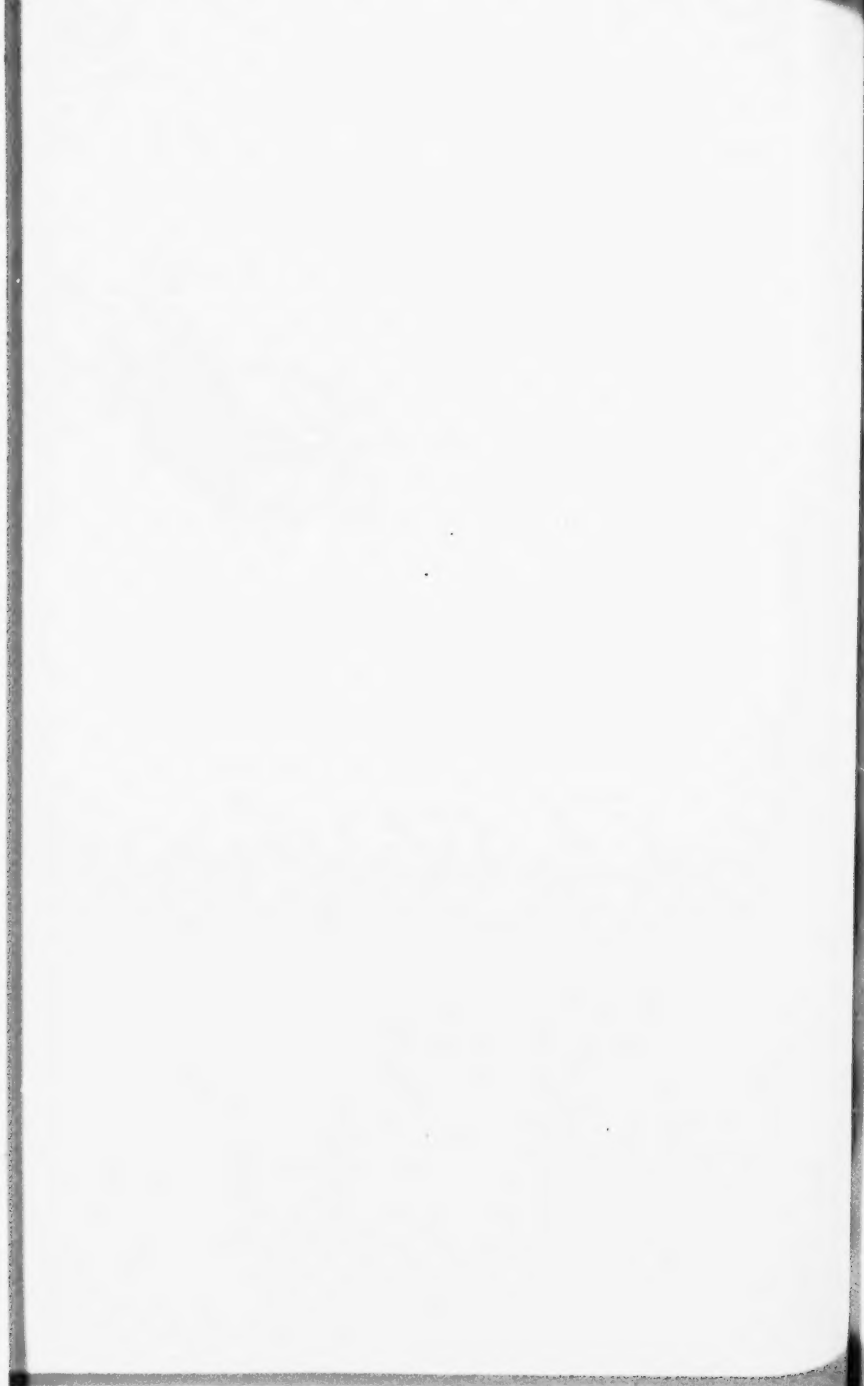
Drawing No. 7.

403 + 426.
Hutchinson & Co. 823
Dryden Co.

Defendant's Quick Action Triple Valve.



Drawing No. 8.



825 10 Q. You have, in substance, stated that the device of complainants' patent No. 360,070 performs by its triple valve the ordinary functions of a triple valve, and is further provided with an additional or auxiliary valve which operates, under certain conditions, to admit air from the main air pipe directly to the brake-cylinder in order to deplete the main air pipe more quickly and thus expedite the application of the brakes upon the succeeding cars; and that in defendants' quick-action triple valves there is no such additional auxiliary valve to perform this quick-action function, but the quick-action function is performed by the triple valve proper. Please explain to the court how and why it is that the defendant's triple valve proper is able to perform this quick-action function, which, in the complainants' structure, requires the presence and action of an additional auxiliary valve.

"Objected to as strongly leading and as making defendants' counsel a witness in so far as it assumes to state the substance of the witness' testimony; and further objected to in view of the assumption which it contains, and which counsel for complainants submits to the court as unwarranted by the witness' deposition, that the defendants' triple valve proper is able to perform the quick-action function."

A. I will explain the mode of operation by which it is possible to make the triple valve proper perform the additional function of admitting air from the main air pipe to the brake-cylinder without adding an auxiliary valve to the triple valve.

I will first briefly state the operation of the valve device shewn in complainants' patent No. 360,070, and then describe the mode of operation of the "defendants' quick-action triple valve," as shown in plat- XI defendants' 1891 catalogue.

The device shewn in complainants' patent No. 360,070 operates as follows: Supposing the device to be charged with seventy pounds of air pressure, as used in practice, and that a quick applica-
826 tion of the brakes is desired, the engineer will reduce the pressure in the main air pipe about fifteen pounds. This reduction will quickly move the piston 12 and the valve mechanism of the triple valve towards the main air pipe, the said movement being due to the preponderance of auxiliary reservoir pressure. In making this movement the piston will come in contact, by suitable intervening mechanism, with the auxiliary valve 41, and thereby open the port leading to the brake-cylinder. The air from the main air pipe at fifty-five pounds pressure will instantly pass to the brake-cylinder through the passage 43.

In the meantime the port 35 (of the main valve of the triple valve) will be placed coincident with the port 23 and in communication with passages 22 and 16, through which the air from the auxiliary reservoir passes to the brake-cylinder, thereby charging the brake-cylinder with air from both the main air pipe and auxiliary reservoir, the main air-pipe air passing through the auxiliary

valve 41, while the air from the auxiliary reservoir passes to the brake-cylinder by another valve formed by the port 35, thereby using two valves in this mode of operation.

(Here follow diagrams marked pp. 827 & 828.)

In the "defendants' quick-action triple valve," see plat-XI defendants' 1891 catalogue, the mode of operation is as follows: Supposing the device to be charged with seventy pounds of air pressure, as in practice, and that a quick application is desired, the engineer will reduce the main air-pipe pressure about fifteen pounds. This will quickly move the piston 29 towards the main air pipe, unseating the main valve 22 of the triple valve, and the air from the main air pipe will pass through the passage F (lifting the check-valve 26) into the triple-valve chamber C, and then pass through the port uncovered by the main valve 22 to the brake-cylinder.

The auxiliary reservoir pressure passes to the brake-cylinder through the same port, uncovered by the main valve 22, which is simultaneously admitting air from the main air pipe to the brake-cylinder. The means by which one valve (22) will admit
829 both main air-pipe air and auxiliary reservoir air to the brake-cylinder is as follows:

1st. The partition dividing the triple-valve chamber C from the auxiliary reservoir end of the piston chamber D; and 2nd, the differential passages A, F and B. By these differential passages, three momentary differential pressures will be established in the valve casing, when the main valve 22 is unseated to produce a *quick* application of the brakes.

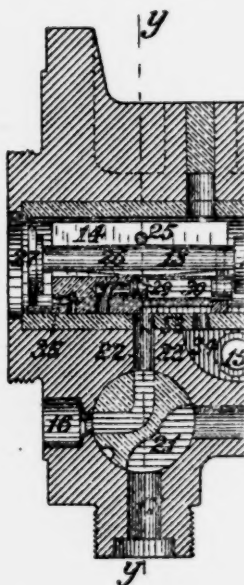
These differential pressures cause one valve (22) to admit the air from the main air pipe and the air from the auxiliary reservoir simultaneously to the brake-cylinder.

The mode of operation is as follows: It will be observed that the passage A from the auxiliary reservoir to the piston chamber D is much larger than the passage B leading from the piston chamber D to the valve chamber C, and that the port uncovered by the valve 22, when fully opened, is much larger than the passage B.

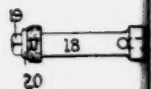
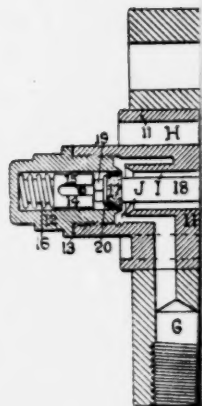
When the piston is *quickly* moved its full stroke toward the main air pipe, as when producing a quick application of the brakes, the valve 22 will be thereby unseated and its port fully opened.

This action will establish three momentary pressures, viz: 1st. Fifty-five pounds on the main air-pipe side of the piston, due to the fifteen pounds reduced by the engineer; 2d. Seventy pounds on the auxiliary reservoir side of the piston 29, due to the supply passage A from the auxiliary reservoir being so much larger than the discharge passage B, thereby partially confining the reservoir air in the space at the reservoir side of the piston; and 3rd, about five pounds in the triple-valve chamber C, due to the port uncovered by the valve 22 *being so much larger than the passage B*, that the air in the chamber C is discharged faster than can be supplied by the restricted passage B. The fifty-five pounds in the main air pipe will then lift the check valve 26 and pass into the triple-valve chamber C, from

PHOTO-F
Complair



PH
"DEFENDANT"
PLATE XI



830 which it will pass to the brake-cylinder through the large port uncovered by the main valve 22, simultaneously with the auxiliary reservoir air which is being supplied through the restricted passage B. The air from the auxiliary reservoir will continue to pass through the valve port uncovered by the valve 22, through which the main air-pipe pressure passed, until the pressure in the auxiliary reservoir and brake-cylinders will have equalized.

By this above operation, air from both the auxiliary reservoir and main air pipe will have passed to the brake-cylinder by one valve when producing a quick application of the brakes, thereby dispensing with the fifth or "auxiliary valve," as used in the operation of the complainants' device shewn in patent No. 360,070.

The essential features necessary to convert a triple valve into a defendants' quick-action triple valve are, 1st, a partition to separate the valve chamber from the piston chamber; and 2nd, differential passages, substantially as described, to establish momentary differential pressure in the triple valve.

11 Q. Referring to the partition which you have described as intervening between the piston chamber D and the valve chamber C, please state how that partition is designated in plate XI of defendants' 1891 catalogue.

A. By the numeral 9.

Adjourned to Friday, April the 28th, 1893, at 10 o'clock a. m., at which time all the aforesaid parties being present, the examination of the witness continued as follows:

12 Q. How would the removal of that partition affect the action of the triple valve, and why?

A. By removing from the defendants' quick-action triple valve the bushing 9, which forms the partition between the valve chamber C and the piston chamber D, the valve would only perform the triple-valve functions known to the art prior to 1887, which functions are, briefly, 1st, charging the auxiliary reservoir; 2d, applying the brakes by the graduating valve port 40 by a slight reduction of the main air-pipe pressure, or fully applying the brakes through the port uncovered by the main valve 22 with auxiliary reservoir pressure alone, and by a greater reduction of the main air-pipe pressure than actuates the graduating valve, and 3d, releasing the brakes by discharging the air from the brake-cylinder through the port J; but by the said removal of the bushing 9, the quick application of the brakes by the admission of main air-pipe pressure to the brake-cylinder would be totally destroyed.

The reason why the quick application of the brakes would be destroyed is that by the removal of the bushing 9 the differential passages would no longer exist, and the differential pressures previously referred to could not be established, as the air from the auxiliary reservoir would pass to the chamber C as fast as it would be discharged from the said chamber C to the brake-cylinder, thereby

maintaining a pressure on the check-valve 26, which would prevent the entrance of air from the main air pipe to the brake-cylinder.

Q. 13. In testifying, in your twelfth answer, as to what effect would result from the removal of the partition or bushing 9, have you testified merely from theory and reasoning, or both from theory and from the demonstration of actual tests?

A. Both from theory and actual tests.

14 Q. Will you please state when, where and with what apparatus such tests were made, and give a full description of the tests and their results?

A. I have made a great many tests, and at various times, at the works of the Boyden Brake Company, in Baltimore, Maryland.

I have made tests on a rack equipped with fifty brakes, just as in practice, provided with all the necessary equipments. The last test I made was on the 25th of this month, in the presence of Mr. Hill, Mr. Church and Mr. Mann. I will describe this last test, which was as follows:

The apparatus I used consisted of an air pump, a main air
832 reservoir and an engineer's valve, to which was connected an equipment representing the air-brake appliances as used on a freight car in practice, viz., a main air pipe, a branch pipe, an auxiliary reservoir, a brake-cylinder provided with the usual brake piston, and the triple valve, "Defendants' Exhibit A," provided with a glass window to show the movement of the interior valve mechanism. In the branch pipe was arranged a glass section, in which latter section was arranged a ball which could freely move in either direction to show in which direction the air moves in the pipes when the quick-action triple valve performs its different functions. The glass cylinder, with the ball, is shown by the sketch which I now make, offer and file as part of my answer.

(See cut illustrating the sketch of glass cylinder and ball, opposite.)

(Here follows diagram marked p. 833.)

I first removed the bushing 9 and placed the triple valve (Defendants' Exhibit A) in its proper position in relation to the brake apparatus, and charged the whole with seventy pounds of air pressure, as used in practice.

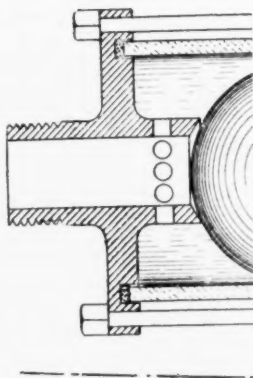
The engineers' valve was then actuated to discharge a slight amount of air from the main air pipe, sufficient to actuate the graduating valve, which opened and let a small amount of air into the brake-cylinder and then closed. The graduating valve was repeatedly opened and a corresponding small amount of air passed to the brake-cylinder each time, in graduated amounts, until the pressure in the auxiliary reservoir and brake-cylinder equalized. The brakes were then released by restoring the maximum amount of air pressure in the main air pipe.

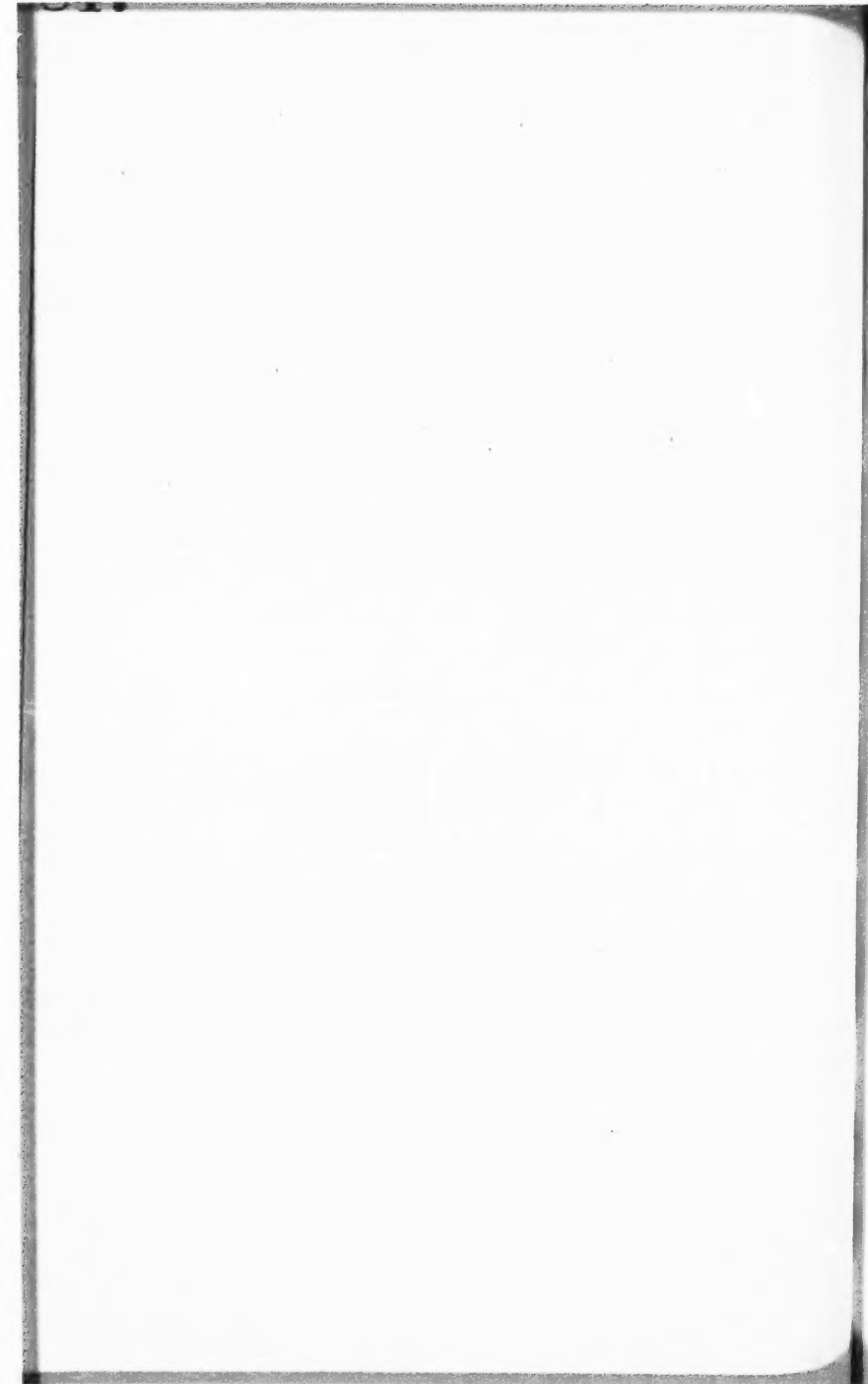
The above operation was repeated several times, the graduating

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REFERRED TC
To

Wc

To Main Air Pipe.





valve operating the same in each test, as observed through the glass window in the side of the valve case.

The above operations gradually and slowly applied the brake.

The apparatus was then charged with seventy pounds of air and the engineers' valve manipulated to discharge a greater amount of air than when graduating. This unseated the main valve
835 22 and the full amount of reservoir pressure quickly passed to the brake-cylinder through the port uncovered by the said main valve.

At the same time the ball in the glass cylinder was closely observed, but it did not move toward the brake-cylinder, showing that, although the main valve 22 was instantly unseated (as observed through the glass window,) no air passed from the main air pipe to the brake-cylinder when the bushing 9 was removed from the defendants' "quick-action triple valve." This operation was repeated several times in various ways, the engineer's valve being actuated the same as when making a quick action of the brakes, but in no instance did the ball in the glass cylinder move toward the brake-cylinder, demonstrating: 1st. That no main air-pipe air passed to the brake-cylinder; and second, that the "defendants' quick-action triple valve" with the bushing 9 removed, was strictly a "triple valve," *per se* as used prior to 1887.

The defendants' quick-action triple valve in the above demonstrations applied the brake gradually, with the graduating valve, and more quickly with the main valve, the two valves performing their functions the same as the device shewn in the Westinghouse patent No. 220,556, patented October 14th, 1879.

The bushing 9 was then replaced in its proper position in the defendants' quick-action triple valve, and then the apparatus charged with seventy pounds of air pressure. The engineer's valve was then manipulated to operate the graduating valve, which operated the same as in the preceding test.

The brakes were then released and the apparatus again charged with seventy pounds of air pressure. The engineer's valve was then operated to discharge a greater amount of air from the main air pipe than when graduating. This operation more quickly applied the brakes than when graduating, because the main valve was unseated, as observed through the glass window in the side of the valve casing.

In these operations the ball in the glass cylinder was
836 closely observed, but in no instance did the ball move toward the brake-cylinder in the act of applying the brakes.

The apparatus was then again charged with seventy pounds of air and the engineer's valve manipulated to quickly and suddenly reduce the pressure in the main air pipe. This action quickly applied the brake and the ball in the glass cylinder instantly jumped toward the brake-cylinder, showing conclusively that when the engineer's valve was properly actuated for quick action, air passed from the main air pipe to the brake-cylinder, when the bushing 9 was in its place in the defendants' quick-action triple valve, as is normally the case in practice. The above demonstrations showed

that when the bushing 9 is removed from the "defendants' quick-action triple valve," only triple-valve functions can be obtained under any circumstances. They also shew that with the bushing 9 inserted, the defendants' quick-action triple valve performs all the triple-valve functions, and in addition thereto, the function of admitting air from the main air pipe to the brake-cylinder without the aid of an auxiliary valve in making a quick application of the brakes or, as it is termed, an *emergency stop*.

The triple valve and casing used in the tests above described was the identical structure here in evidence marked "Defendants' Exhibit A." In these tests the glass cylinder provided with the ball was slightly inclined downward from its triple-valve connection towards its main air-pipe connection, so that the ball would normally rest against the main air-pipe end of the glass cylinder, and when forced away from that position by the passage of air from the main air pipe towards the triple valve, the ball would afterwards return automatically or roll back to its normal position.

Recess.

15 Q. You have stated the fact that, in defendants' quick-action triple valve, if the bushing 9 be removed, the apparatus will
837 act simply as a triple valve, like the triple valve of the

Westinghouse patent dated October 14th, 1879, No. 220,556, and that, with said bushing in its place, it will perform the same functions in the same way, and, when the engineer's valve is properly actuated for an emergency stop, the triple valve will perform the additional function of admitting air directly from the main air pipe to the brake-cylinder; I would like, now, to have you inform the court whether these results are dependent, in any way, upon the peculiar form of the graduating device, or the peculiar form of the main valve 22, of your triple valve, or whether the same results would be produced with other forms of graduating or main valves substituted for the form shown in plate XI of defendants' 1891 catalogue?

Objected to as irrelevant and immaterial.

A. It does not matter what form or class of valves is used for those shewn in defendants' quick-action triple valve.

16 Q. Is this last answer a matter of mere opinion with you, or have you demonstrated the fact experimentally?

Same objection which is continued without further notice as to this entire line of examination.

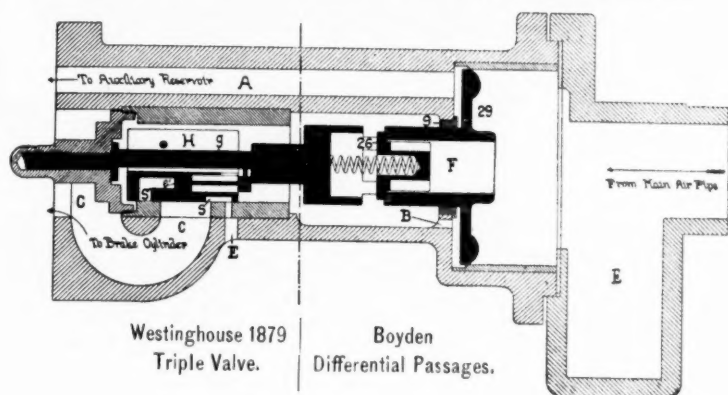
A. It is not a matter of mere opinion, as I have used various forms of valves instead of those used in the defendants' quick-action triple valve, as shewn on plate XI, defendants' 1891 catalogue.

In the device shewn in the defendants' Exhibits B and C, and cut No. 10 (of "illustrative cuts")

(Here follows diagram marked p. 838.)

DEFENDANT'S EXHIBIT, "ILLUSTRATIVE CUTS."

Westinghouse Ordinary "Triple Valve" with Boyden Differential Passages.



Drawing No. 10.

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I have arranged, with the partition and differential passages of the defendants' quick-action triple valve, the slide and graduating valve mechanism of the Westinghouse patent No. 220,556, patented October 14th, 1879, and with this arrangement of the valve mechanism and differential passages of the defendants' quick-action triple valve, I have obtained the same results as with the defendants' quick-action triple valve.

17 Q. Is Defendants' Exhibit B the identical structure with which you made some of those experiments referred to in your last answer?

840 A. It is.

18 Q. Is Defendants' Exhibit C an exactly similar structure, having the valve casing cut in two, to reveal the construction of the interior parts?

A. It is.

19 Q. Please describe to the court the experiments which you made with Defendants' Exhibit B, referred to by you, stating what your tests were and what the results were.

A. I made several tests in the presence of Mr. Hill, Mr. Church and Mr. Mann at the Boyden Brake Company's works on the 25th of this month.

I used the same apparatus that I used in making the demonstrations wherein the defendants' quick-action triple valve (Defendants' Exhibit A) was used, except that I used Exhibit B in place of Exhibit A.

I first removed the bushing 9 and placed the device in its proper position in relation to the other parts of the apparatus. I then charged the apparatus with seventy pounds of air pressure and actuated the device just the same as I did when using Defendants' Exhibit A without the bushing. The results obtained were precisely the same as those obtained from Defendants' Exhibit A. I then placed the bushing 9 in its proper place and charged the whole with seventy pounds of air pressure, and actuated the device just the same as when using Defendants' Exhibit A with the bushing 9 in its proper place. The results obtained was precisely the same as those obtained from Defendants' Exhibit A.

In using the device, Defendants' Exhibit B, with the bushing removed the graduating, the main and the release valves performed their functions the same as described in the Westinghouse patent, No. 220,556, of October 14th, 1879. When the bushing 9 was put in its proper place in Exhibit B the valves performed all the triple-valve functions as above stated, and these valves of the 1879 patent, in addition, (when the engineer's valve was actuated to produce a quick application of the *the* brakes), admitted the air from

841 the main air pipe to the brake-cylinders, as observed by the ball in the glass cylinder jumping toward the brake-cylinder.

These experiments with the Defendants' Exhibit B demonstrated that the form of the valves plays no part in converting a triple valve proper into a quick-action triple valve.

20 Q. You described, in answer 14, your experiments with Defendants' Exhibit A. Please state whether Defendants' Exhibit

"Section of Defendants' Exhibit Triple Valve, Plate XI, 1891 Catalogue," is a structure exactly similar to Defendants' Exhibit A, except that it has the valve casing cut in two to reveal the construction of the interior parts.

A. It is.

21 Q. If you should take the defendants' quick-action triple valve shown in plate XI, defendants' 1891 catalogue and in Defendants' Exhibit A, and plug up the port 40, which forms the graduating valve, what effect would it have on the operation of the triple valve?

A. If the port 40 was plugged and the engineers' valve was manipulated the same as it would be to operate the graduating valve, the main valve 22 would be slightly unseated and discharge a small amount of auxiliary reservoir air to the brake-cylinder, and then close, producing the same result as though the graduating valve was not plugged, the only difference being that its action would not be quite as delicate as that of the graduating valve.

22 Q. Is this last answer a matter of mere opinion with you, or have you demonstrated it experimentally?

A. It is not a mere opinion with me, as I demonstrated that it would act as I have stated. This demonstration was made in the presence of Mr. Hill, Mr. Church and Mr. Mann, at the factory of the Boyden Brake Company on the 25th of this month. I have also demonstrated that the main valve 22 would take the place of the graduating valve, by trying the experiment on several brakes connected as they would be in practice on a train.

842 23 Q. If you have ever placed anything behind the check-valve 26, of defendants' quick-action triple valve, so as to prevent it from lifting, state the facts and the result upon the action of the valve device.

A. I have placed a comparatively strong spring back of the check-valve 26. The result of this was that it prevented the check-valve from opening, and thereby prevented the air from the main air pipe passing to the brake-cylinder, thus destroying the quick-action function of the device.

24 Q. Please refer to the quick-action brake-valve illustrated in plate IX, of defendants' 1889 catalogue, and compare that structure briefly with the structure shown in plate XI, of defendants' 1891 catalogue, and explain to the court whether there is or is not any substantial difference between said two structures in their mode of operation and practical results, or in the essential elements which act by that mode of operation to produce those results?

A. There is no difference in the mode of operation or results. The piston, partition, and the differential passages are the same, they being the elements which produce the mode of operation; the difference being that a different form of main, graduating, and release valves is used, which valves are equivalents in both devices.

25 Q. Please give a brief history of the origin and development of the air brake invented by you and used by the defendants?

A. I took out my first patent for air brake in 1883, which patent, No. 280,285, has been mentioned in my testimony. I could not use

his patent at that time, owing to the Westinghouse patents of 1872 being then in force.

About the year 1881 or 1885 I conceived an idea of a brake operated by springs and air pressure, on which I took out several patents, two being dated Nov. 8th, 1887. I incorporated a company with several gentlemen here in Baltimore, and proceeded to perfect and put in operation the spring and air brake referred to.

43 After spending a great deal of time and money, the brake was reduced to a practical form, with many other devices necessary to make a complete brake system, such as air pumps, governors, engineers' valves, locomotive driver and tender brakes, pipe connections, &c.

When this was all accomplished, after two or three years of labor, we equipped a train of twenty-five refrigerator cars and a locomotive with the above-mentioned brake equipments for the Baltimore and Ohio railroad.

This train was taken on a long trip over the heaviest grades on the B. and O. railroad. A great many tests were made under supervision of the officials of that road. This train worked entirely satisfactory in every particular during the trials, which lasted four days. Having met with success in these experiments, we were able to interest a large number of persons, and procured sufficient capital to start in business.

At this juncture, the beginning of 1889, the question arose whether we should continue making the spring and air brake or use an air brake embodying the "automatic" features of the Westinghouse patent No. 124,401, patented March 5th, 1872, and which expired about this time (1889).

As the Westinghouse automatic patents had now expired, we, of course, were at liberty to use these devices.

Prior to 1888 I designed a quick-action valve, embodying the essential features of the "defendants' quick-action valve"—the partition and differential passages, the check-valved passage, and the single valve to admit auxiliary reservoir and also main air-pipe air to the brake-cylinder—the design being substantially that shown on plate IX, defendants' 1889 catalogue.

Now, having two systems of brakes, viz: the automatic quick-action air brake, and the spring and air brake, the question arose, as before stated, what system of brakes our company should adopt, and it was decided to adopt the quick-action air brake, owing to the fact that the Westinghouse 1872 patents had expired, thereby giving us the right to use the "automatic" features; and as the automatic class of brake was well known and introduced, we considered that it would be easier to introduce our

44 air brake than the spring brake.

We then established a plant here in Baltimore, and equipped it with special machinery to manufacture our quick-action automatic air brake.

We then began to manufacture said brakes with the necessary adjuncts, such as the air pumps, governors, engineers' valves, also locomotive driver brakes and tender brakes.

Since that time we have introduced the devices we have manufactured, on about fifty or sixty railroads, and are now continuing to supply the devices.

When we adopted our quick-action automatic air-brake system, we felt that we had a perfect right to do so owing to the fact of the expiration of the Westinghouse automatic patent, and that our quick-action valve was not an infringement on any existing patent, we considering our quick-action valve to involve a distinct and separate invention from any then in use, as it embodied a principle of our 1883 patent, and *my differential passages* by which the triple valve was made to perform the additional function of admitting main air-pipe pressure to the brake-cylinder without the addition of an auxiliary valve.

Our understanding was that the Westinghouse patent No. 360,070, was for a triple valve, to which was added an auxiliary valve, and that the defendants' quick-action triple valve was not an infringement of that patent, we being advised to that effect by Mr. C. B. Mann, patent attorney of this city.

We also procured the opinion, on this matter, of Mr. Ellis Spear, ex-Commissioner of Patents, who concurred with the views of Mr. Mann.

Adjourned to Saturday, April 29th, 1893, at 10 o'clock a. m.

Saturday, April 29th, 1893, at 10 o'clock a. m., the same parties met, and adjourned to 2 o'clock p. m. of the same day. At 2 o'clock p. m. they again met and then adjourned to Monday, the 1st day of May, 1893, at 10 o'clock a. m.

845 At which last-mentioned time they again met and proceeded as follows:

Cross-examination of Mr. GEORGE A. BOYDEN by J. SNOWDEN BELL, Esq., of counsel for complainants:

X 26 Q. It is a fact, is it not, that you are familiar with letters patent for inventions, and that you were, for some time, in actual practice as a solicitor of patents in this city?

A. It is. I practiced about three years before the Patent Office as a patent solicitor.

X 27 Q. The 1889 and 1891 catalogues of the corporation defendant, copies of which are in evidence on behalf of complainants, were prepared by you, or by or under your directions and instructions, were they not?

A. Partially so. The cuts were prepared under my direction; the reading matter was prepared principally by Mr. C. B. Mann; and Mr. William L. Bailie, as I was busy at that time in mechanical matters.

X 28 Q. You were, however, familiar with both the cuts and the 1889 and the 1891 catalogues, and the same were issued with your personal approval, I presume?

A. To a certain extent, yes; but having placed the preparation of the reading matter in the hands of Mr. Bailie and Mr. Mann, I did

not give the reading matter as close scrutiny as I did the cuts. Therefore, I could testify that the cuts are absolutely correct, whereas, as to the reading matter, I am not so positive.

X 29 Q. You also devised and prepared, or caused to be made under your direction, the series of drawings offered in evidence as Defendants' Exhibits Illustrated Cuts, is this a fact?

A. It is.

X 30 Q. Do you find "the Westinghouse quick-action triple valve, shown in Defendants' Exhibit of Section of Westinghouse Triple Valve of Patent No. 360,070 (red valve)," to accord, in all substantial particulars of construction and operation, with the quick-action triple valve, described and shown in said patent No. 360,070?

846 A. As to the construction, I do find that it is like the complainants' patent No. 360,070. As to its operation in practice, I was present at its trial on fifty cars at the Burlington test in the spring of 1887. At those tests where it was operated, it did not produce the quick action to overcome the shocks between the cars at the rear of the train which it was intended to do, as set forth in complainants' patent No. 360,070, and I believe it was abandoned after those tests.

X 31 Q. I do not think that you have correctly understood my question, and I will therefore repeat cross-question thirty with the explanation that what I want to know is whether you find that the quick-action triple valve inquired about accords or agrees in all substantial particulars of construction and *mode or manner* of operation, with that described in patent No. 360,070.

I am not enquiring at all about the degree of perfection with which the valve operated or the degree of satisfaction attained in the results of its operation.

A. I consider the construction and mode of operation of the valve to correspond with that set forth in complainants' patent No. 360,070.

X 32 Q. Is the description of "the construction and operation of the Westinghouse quick-action triple valve shewn in Defendants' Exhibit Section of Westinghouse Triple Valve of Patent No. 360,070 (red valve)" which you give in answer six, intended by you to be taken as a statement of your understanding of the construction and mode of operation of said quick-action triple valve, as described and shewn in said patent No. 360,070, or is it a statement of your understanding of a construction or mode of operation of said quick-action triple valve differing in any particular from the construction and mode of operation shewn in said patent No. 360,070, and derived from any source other than or exterior to said patent?

A. It is partially from the specification and partially from my understanding how the device would work in practice.

847 X 33 Q. Is the description of the construction and mode or manner of operation of the Westinghouse quick-action triple valve of patent No. 360,070, which is recited in said patent, in your opinion *incorrect* in any particular, and if so, please state fully in *what* particular?

A. I think the specification describes the construction and mode of operation correctly, except as I recall it, it does not state how the valve would operate if a gradual and continuous limited amount of air were discharged from the main air pipe sufficient to slowly move the piston its full stroke.

The result of such action would be not to produce a quick application of the brakes, but it would bring the port 35, forming the main valve, coincident with the passage leading to the brake-cylinder, thereby partly passing the air from the auxiliary reservoir to the brake-cylinder through the port 35.

X 34 Q. In your answer six you say, as to "the Westinghouse quick-action triple valve shewn in Defendants' Exhibit Section of Westinghouse Triple Valve of Patent No. 360,070 (red valve)," that "This is a valve mechanism used in automatic air brakes, the functions of which are: 1st. * * * 2nd. * * * 3rd. * * * 4th. * * *."

Is it not the fact that one of the most *essential* and *important* functions of the "valve mechanism" referred to is, "effecting the admission of air directly from the main air pipe 2 to the brake-cylinder 7 when it is desired to apply the brakes with great rapidity and full force," as stated in lines 47 to 51, page 3, of patent 360,070.

Is it not also the fact that the function just quoted by me is not included, either directly or by implication, in either the 1st, 2nd, 3rd or 4th functions recited by you in answer six?

A. Pertaining to the first part of your question, wherein it states that I have recited four functions: When describing these functions, I was giving a description of the four valves that form a triple valve proper, and in the operation of these triple valves I do
848 not consider that the admission of main air-pipe air into the brake-cylinder is essential.

It is true, however, that, as a valve device, the quick action function is essential, but this function plays no part in the complainants' triple-valve mechanism, as it, the quick-action function, is accomplished by a valve independent of the triple valves. This auxiliary valve and its function I fully described after describing the triple valve proper.

Answer objected to as not responsive.

X 35 Q. X 34 Q. repeated, and the witness is requested to answer its two branches severally. The attention of the witness is also called to the fact that in question six he was not asked anything about "the four valves that formed the triple valve proper," but *was* asked to describe the construction and operation of "the Westinghouse quick-action triple valve shown in Defendants' Exhibit Section of Westinghouse Triple Valve of Patent No. 360,070 (red valve)?"

A. In my answer six in chief, in order to make clear what I understood the complainants' quick-action triple valve to be, I adopted the method of first describing the triple valve proper and its functions, just as the specification of complainants' patent No. 360,070 does. Afterwards I proceeded to describe those parts which were

added to the complainants' triple valve proper to make it perform the additional function of admitting the main triple air to the brake-cylinder. As the last-mentioned function did not pertain to the triple valve proper in the complainants' device, I did not enumerate it among those of the triple valve, but reserved it for the last.

In speaking of the triple valve proper, I do not consider the auxiliary-valve part of the triple valve, and especially so, as, in the complainants' patent No. 360,070, it is stated as follows: "So far as hereinbefore described, the triple valve accords, in all substantial particulars, with, and is adapted to operate similarly to, those of

my letters patent Nos. 168,359, 172,064 and 220,556, and in
849 order that it may perform the further functions requisite in the practice of my present invention, it is provided with certain additional members, which will now be described."

The specification then goes on to describe an additional valve to admit the main air-pipe air to the brake-cylinder. Therefore, I do not consider that the function of admitting the main air-pipe air to the brake-cylinder has anything to do with the triple valve proper.

If, however, the complainants' device is alluded to as a whole, then one of the essential and important functions of the *valve mechanism* is to "effect the admission of air directly from the main air pipe, 2, to the brake-cylinder, 7, when it is desired to apply the brakes with great rapidity and full force."

X 36 Q. Then, if I understand you correctly, you now unhesitatingly admit that, "effecting the admission of air directly from the main air pipe, 2, to the brake-cylinder, 7, when it is desired to apply the brakes with great rapidity and full force," is one of the most *essential* and *important* functions of "the Westinghouse quick-action triple valve shown in Defendants' Exhibit Section of Westinghouse Triple Valve of Patent No. 360,070 (red valve)."

A. I do, when a quick application of the brakes is desired, but my understanding is that the triple valves proper in the complainants' device have nothing to do with performing that function, as it is performed by an additional valve auxiliary to the triple valve.

All of the last preceding answer subsequent to the word "desired" objected to as not responsive and a mere voluntary statement, the question relating in terms strictly to the exhibit before the witness, as an entirety, and having nothing to do with such portions of said exhibit whatever they may be, which the witness designates as the "triple valve proper."

X 27 Q. You will, also, I presume, unhesitatingly admit that the *essential* and *important* functions of "the Westinghouse quick-
850 action triple valve, shown in Defendants' Exhibit Section of Westinghouse Triple Valve of Patent No. 360,070 (red valve)," is not included, either directly or by implication, in either the first, second, third or fourth functions specified by you in answer six.

Will you make this admission?

A. If the essential feature you refer to is the admission of air

from the main air pipe to the brake-cylinder I will admit the above.

Recess.

X 38 Q. Through an inadvertence on my part causing needless delay, for which I own myself responsible, cross-question thirty-seven was, as is very plainly indicated by your answer, incomplete. I will therefore put it in the form in which I should have originally put it, to wit:

You will, also, I presume unhesitatingly, admit that the *essential* and *important* function of "the Westinghouse quick-action triple valve shewn in Defendants' Exhibit Section of Westinghouse Triple Valve of Patent No. 360,070 (red valve)" to wit: "effecting the admission of air directly from the main air pipe, 2, to the brake-cylinder, 7, when it is desired to apply the brakes with great rapidity and full force is not included, either directly or by implication, in either the 1st, 2nd, 3rd, or 4th functions specified by you in answer six."

Will you make this admission?

A. With the understanding that the term, Westinghouse quick-action triple valve, as used in your question, includes an auxiliary valve, I will.

X 39 Q. I call your attention to the fact that I was careful to use in cross-question thirty-eight the same language that was used in question six to designate the thing, device or structure, the construction and operation of which you were asked in question six to describe.

Did you not in answering question six, and do you not now, understand that, by that language, was and is meant the *entire* structure, thing or device which it recites?

A. That is my understanding of it, but in my description of the device, I first described the triple valve proper as it existed substantially, prior to 1887, and then described that element, (the additional valve) which admits the main air-pipe air to the brake-cylinder.

X 40 Q. Your understanding being that you were asked to describe in *question six* the construction and operation of the *entire* structure, thing or device designated in the question. When you commenced your answer to question six by the statement "This is a valve mechanism used in automatic air brakes," you meant by the term "valve mechanism" which you used therein, the entire structure, thing or device, did you not?

A. Yes, I did, and by the term, "valve mechanism," I meant to apply a triple valve proper and an additional valve to admit the air from the main air pipe to the brake-cylinder.

X 41 Q. Inasmuch as you meant by the term, "valve mechanism," the entire thing, structure, or device, you were asked to describe; you will now admit, will you not, that when you stated in answer to six that the functions of that "valve mechanism" are 1st, 2nd, 3rd, and 4th, as recited in the first paragraph of that answer, you were in error in not specifying another function, to wit: the

direct admission of air from the main air pipe to the brake-cylinder, such function being as you have heretofore admitted, an essential and important function of the entire thing, structure or device you were describing?

A. No, I will not admit that I am in error, because, 1st, in describing the triple valve proper I specified the four functions which the triple valve proper produces; and 2nd, I then described the device of an additional valve to the triple valve proper, which additional valve produces the function of admitting main air-
852 pipe air to the brake-cylinder,—this not being a function performed by the complainants' triple valve proper.

X 42 Q. Inasmuch as question six makes no mention of the thing, whatever it may be, that you are pleased to term "the triple valve proper;" inasmuch as you understood question six called for the description of the entire thing, structure or device which it designated; and inasmuch as you used the term "valve mechanism" in the opening sentence of the answer, to mean the *entire* thing, structure or device, will you now maintain that you were correct in omitting the function of admitting directly air from the main air pipe to the brake-cylinder from your enumeration of the functions of the "valve mechanism" you described?

I call your attention to the fact that in commencing this description in answer six you did not say a word about the "triple valve proper," but, on the other hand, began your answer by the statement: "This is a valve mechanism used in automatic air brakes, the functions of which are 1st, * * *, 2d * * *, 3d * * * and 4th * * *"

A. What I meant by "valve mechanism" was the whole of complainants' quick-action valve mechanism. In the first part of my answer I described the triple valves and their functions as forming part of the valve mechanism. In the same answer I described those parts (an additional valve) which performed the quick-action function of admitting main air-pipe air to the brake-cylinder. Therefore what I mean by "valve mechanism" is the triple valve proper, and an additional valve to the triple valve, in the complainants' valve mechanism.

As the "auxiliary valve" of the complainants' valve mechanism does not perform any function of the triple valve proper, I could not consistently include its functions in the four functions of the triple valve proper. Therefore I was not in error at the time I described the triple valve by not including it among the triple-valve functions. However, immediately after the description of
853 the triple valve proper I described the auxiliary valve and function.

As the specifications of complainants' patent No. 360,070 first describes the triple valve proper, and then follows with a description of the auxiliary valve to perform the new functions of admitting main air-pipe air to the brake-cylinder, I followed, in my description, the order adopted in the said specification, as I considered that was the proper order in which to proceed.

X 43 Q. By reason of your frequent use of the term "the triple

valve proper," a term which I am unable to discover in question six, or in the initial clause of your answer immediately preceding your enumeration of functions, or, possibly by reason of my own obtuseness, I am still unable to understand what warrant or justification you believe you have for omitting what may be briefly termed the quick-action function from your enumeration of the functions of "the Westinghouse quick-action triple valve shown in Defendants' Exhibit Section of Westinghouse Triple Valve of Patent No. 360,070 (red valve)."

You say in answer to cross-question forty-two: "What I meant by valve mechanism was the whole of complainants' quick-action valve mechanism." Now, as you say in answer six, referring to complainants' quick-action valve mechanism. "This is a valve mechanism used in automatic air brakes, the functions of which are: 1st, * * *; 2d, * * *; 3d, * * *; 4th, * * *."

I will terminate this branch of the examination by asking you to state, for the information of the court, what warrant or justification you believe you have for omitting the quick-action function from your enumeration of the functions of the "valve mechanism" referred to by you in the first paragraph of answer six, that is to say, in your own language, "the whole of complainants' quick-action valve mechanism."

Objected to by defendants' counsel as containing, and based upon, an essential misunderstanding of the witness' answer to interrogatory six, which *did* refer to, and describe, the entire mechanism of complainants' structure, including the *auxiliary valve* 854 as well as the triple valve, and *did* enumerate the *fifth* function of that mechanism, to wit, the function of admitting main air-pipe air directly to the brake-cylinder. The witness' answer six must be read as a whole; and, as a whole, it fully answers the sixth interrogatory, in the broadest sense in which it is capable of being construed. But if you take a single clause of that answer, apart from the rest, it is clear that it does not, and was not intended to, cover the entire scope of the question.

Counsel for complainants submits to the court that the foregoing alleged "objection" of counsel for defendants is wholly unwarranted and entirely improper, it being upon its face a mere argument upon the record and an indication to the witness of the character of the answer, which he could make to the last preceding question. If counsel for complainants has misunderstood the witness' answer, such understanding, if there be one, is no ground for an objection, and does not, in anywise, make the question objectionable, because if the witness supposed that counsel had misunderstood his answer six, the question gave him a full opportunity of correcting such misunderstanding, if it were necessary for him to do so, in order to answer truthfully, and if it were not it would be altogether immaterial whether there was any such misunderstanding. Between a *misstatement* of the witness' testimony, and a *misunderstanding* of it, there is a wide range of difference.

The former would render the question objectionable; the latter prejudices, if at all, only the examining counsel.

Defendants' counsel replies that his objection was based exactly upon the fact that the misunderstanding which he referred to had resulted in a gross misstatement of the witness' testimony 855 given in answer six, and was put on the record to instruct complainants' counsel and not the witness. Defendants' counsel did not wish to say that complainants' counsel had misstated the testimony; because he believed that it had been done through misunderstanding of it, and he desired to call the attention of complainants' counsel to the fact that interrogatory six, in the broadest sense of its terms, had been fully and completely answered in answer six, where the witness, after describing the four first functions, peculiar to the triple valve alone, had then described the fifth function, peculiar to auxiliary valve, and had enumerated them all as coming within the terms of the *entire* structure referred to in interrogatory six.

Counsel for complainants renews his objection and protests against the impropriety of the remarks of counsel for defendants, in view of the plain instructions they convey to the witness, and further demands of counsel for defendants that he indicate to the court specifically and fully the alleged "gross misstatement" of the witness' testimony, which, in his preceding rejoinder, he has charged against counsel for complainants:

Defendants' counsel replies that the question is plainly and obviously objectionable in this, to wit: that it asks the witness what warrant or justification he has "for omitting what may be briefly termed the quick-action function from your" (his) "enumeration of the functions of 'the Westinghouse quick-action triple valve, shown in Defendants' Exhibit Section of Westinghouse Triple Valve of Patent No. 360,070 (red valve).'"

Now, the witness did not omit said quick-action function from his enumeration of the functions of "the Westinghouse quick-action triple valve shown in Defendants' Exhibit Section of the Westinghouse Triple Valve of Patent No. 360,070 (red valve)." On 856 the contrary, he clearly and fully enumerated and described it in his sixth answer; and it is a great perversion of his testimony to assume, as the present question does assume, that he omitted it. Defendants' counsel objected to the question for that reason, and, supposing the misstatement to have been unintentional, he preferred, in his objection, to use the word "misunderstanding" rather than "misstatement."

Counsel for complainants believing that the interference with his right of cross-examination, due to the instructions of defendants' counsel to the witness under the guise of objections, will be reviewed by the court at the hearing, submits thereto under protest, and will not continue this discussion further. He requests counsel for defendants, however, to state specifically, for the information of the court, whether the alleged objectionable matter in the question which is recited by defendants' counsel in his last preceding reply,

constitutes the "gross misstatement of the witness' testimony" charged by defendants' counsel in his first reply.

Defendants' counsel replies that it constitutes one of the principal misstatements of the question, but that the whole question, in its false assumption of the testimony of the witness in answer six, is practically a misstatement from beginning to end. It assumes that the witness was asked, in interrogatory six, about the entire structure; that, in commencing to answer the question, he intimated that he was answering as to the entire structure; and that he, then, went on to answer only as to the functions of the triple valve itself, without including the fifth function, to wit: the quick-action function. Any one who will intelligently read the witness' sixth answer, will see at a glance that it is capable of no such construction
857 or interpretation, and that its meaning is essentially perverted and misrepresented in the present cross-interrogatory.

The witness has, already, in his cross-examination, fully explained these facts, and shown that he understands the matter just as defendants' counsel does, and as defendants' counsel has stated in the objection here under discussion.

There is, therefore, no warrant or excuse for the intimation of complainants' counsel that the objection was made in order to lead the witness.

The objection simply embodies what the witness had in substance testified to, in his answers to the three or four cross-interrogatories immediately preceding the present one.

Counsel for complainants not being able to cross-examine more than one witness at a time, and it being now close to the hour of adjournment, instructs the witness that it is his duty to abstain during the adjournment from all communication, direct or indirect, with counsel for defendants as to the cross-question which is now awaiting his answer, and shall also abstain from consulting or referring to the arguments or statements which have been placed upon the record by the counsel for the defendants.

The witness states that he will answer the question before adjournment, and then proceeds as follows:

A. I will explain to the court my understanding of what the several terms used in my testimony mean. 1st, the term "complainants' quick-action triple-valve" means the complainants' entire structure, consisting of a triple-valve proper, or *per se*, (which performs the triple-valve functions), and an "auxiliary valve" to perform the additional function of admitting main air-pipe air to the brake-cylinder. 2nd, the term "valve mechanism" includes all of complainants' valve mechanism, the same as enumerated under the first head. 3rd, the term "triple valve proper," and the term "triple valve, *per se*," are the same, and mean those valves which only perform the triple-valve function, but do not include
858 the *additional valve* of complainants' device which admits main air-pipe air to the brake-cylinder.

In my answer to question six, my intention was to, and I did, describe all the parts of complainants' device, and I started out by

using the term "valve mechanism," meaning by that that I was going to describe the complainants' complete device.

I started by first describing the triple valve proper, and pointing out its functions. In describing the triple valve proper, I did not mention the "auxiliary valve" or its function, because, in the complainants' device, the auxiliary valve and its function had nothing to do with the functions of the triple valve.

Therefore, I could not consistently allude to the auxiliary valve when describing the *triple valve proper*. However, I immediately proceeded to describe the auxiliary valve and its function, after I described the triple valve and its functions.

This is the reason why I did not mention the auxiliary valve and its functions, in describing the triple valve proper. But, before I finished my answer to the sixth question, I fully described the "valve mechanism" of the complainants, as that term (valve mechanism) included both the triple valve proper and the "auxiliary valve."

Adjourned to Tuesday, May 2nd, 1893, at 10 o'clock a. m. At 10 o'clock a. m., Tuesday, May 2nd, 1893, the same parties pursuant to adjournment met and proceeded as follows:

X 44 Q. In your answer to cross-question 43 you say "I started by first describing the triple valve proper and pointing out its functions."

Now will you not admit that in making this statement you fell into the error of confounding what you may have desired or intended to do, with what you actually *did* do, that is to say, that instead of starting your answer by describing some portion which you selected of the entire structure enquired about and designated "the triple valve proper" you did, as a matter of fact, start by stating as to the entire structure enquired about that "this is a valve mechanism used in automatic air brakes, the functions of which are: 1st * * *, 2nd * * *, 3rd * * *, 4th * * *," and that after having reciting four *functions* and not described four valves, or *any* valves, you next proceeded after your recital of the functions of the "valve mechanism," to describe the operation of what you called a "triple valve" proper.

In order that you may not be misled, and may have full opportunity of correcting any mistake you may have made, I refer you to your answer to cross-question thirty-nine, in which you admitted that in answering question six you understood the language of the question to refer to the *entire* structure, thing or device which it recited.

I also refer you to your answer to cross-question forty, in which you admit that in answering question six you meant by the term "valve mechanism" the *entire* structure, thing or device inquired about.

I also refer you to your answer to cross-question forty-two, in which you state that "what I meant by 'valve mechanism' was the whole of complainants' quick-action valve mechanism" (referring to your answer six).

I also refer you to your answer to cross-question forty-three, in

which you state that: "1st, the term 'complainants' quick-action triple valve' means the complainants' entire structure * * *. 2d, the term 'valve mechanism' includes all of complainants' valve mechanism" (referring to your answer six).

Counsel for defendants say:

This question, and all questions that may be asked of the same general character, are objected to as immaterial, wasting time on frivolous verbal quibbles, said quibbles apparently being based upon the fact that the witness, in his answer six, commenced by referring to the valve mechanism (the "red valve" of the question) as an entirety, *but did not describe the whole of that entirety in his first sentence.*

860 Counsel for complainants renews his objection to and protests against the grossly improper course pursued by counsel for defendants, in continuing to instruct the witness by statements, in the guise of objections as to what the witness did say and what he did not say, and similar indications as to what he is expected to say.

Counsel for defendants replies that the good sense of the court will readily determine which of the two counsel is pursuing a "grossly improper course" in this matter.

A. I don't think I have made any error in my answer to question six. In that answer as a whole I described the complainants' entire quick-action triple valve. I first started by stating the functions of the triple valve proper and then described the operation of the triple valve. In this description I used the numerals of complainants' patent No. 360,070, to designate the valves. After this description I proceeded to describe the auxiliary valve, or those parts which admit the main air-pipe air to the brake-cylinder to produce the quick application of the brakes.

I adopted this mode of description of the complainants' quick-action triple valve, to make clear to the court what a triple valve proper was, as it existed prior to 1887, and then described those parts which produce the quick application of the brakes in complainants' quick-action triple valve.

Therefore, I don't think I have erred in my description of the device, and I think any one reading the whole of my answer to question six, with a view of ascertaining what the complainants' quick-action triple valve is, cannot fail to understand the same.

X 45 Q. While your reason for continually talking about the "triple valve proper" appears perfectly obvious from the theory attempted to be set up in your deposition, and in the "objections" of defendants' counsel, I am unable to find in question six any inquiry whatever as to the thing you call the "triple valve

861 proper," and from your answer to cross-question thirty-nine I don't find that *you* understand that it inquired about such a thing.

Now, for the information of the court, please indicate specifically any portion of question six which asks for a description of the con-

struction or operation of the thing you call the "triple valve proper?"

A. Question six refers to the entire device of the complainants' quick-action triple valve, and my answer as *an entirety* relates to the whole of complainants' quick-action triple valve, giving a description of the entire device. I had to begin to describe some part of it, and I elected those parts of the triple valve proper to begin with. Necessarily I had to use appropriate terms to denote the parts, therefore I used the term "triple valve proper" to designate that part of the device. I think this mode of procedure is wholly consistent, in view of the fact that Mr. Westinghouse, in applying for his patent No. 360,070, in describing to the Patent Office what his invention was, *first* described the triple valve proper, and *then* described those parts which produced the quick action. Therefore I feel that I am justified in describing complainants' quick-action triple valve as I did in my answer to question six.

I wish it distinctly understood that I was not attempting to "set up" a "theory" in my description of the complainants' quick-action triple valve, as the description I gave is just what the device consists of.

X 45½ Q. You say, in answer to cross-question forty-four (referring to your answer six): "I first started by stating the functions of the triple valve proper, and then described the operation of the triple valve."

Now, in view of the fact that the record shows that you "first started" by saying: "This is a valve mechanism used in automatic air brakes, the functions of which are: 1st, * * *; 2d, * * *; 3d, * * *; and 4th, * * *;" and in view of the further fact in your answers to cross-questions forty, forty-two and forty-three you have admitted that by the term "valve mechanism" you meant the entire thing, structure or device inquired about in question 62 six, please indicate specifically, for the information of the court, what language you used when you "first started" in answer six, or used prior to your recital of functions 1st, 2d, 3d and 4th therein which would indicate to any one capable of understanding the meaning of language that said recital of functions 1st, 2d, 3d and 4th were the functions of "the triple valve proper?"

A. I will quote the exact language I used, which is as follows: "This is a valve mechanism used in automatic air brakes." I then went on to state the functions of the triple valve proper, and the operation of the triple valve proper, as being part of the *valve mechanism*." After the description of the triple valve proper, I proceeded to describe the "auxiliary valve" which admits the main air-pipe air to the brake-cylinder, this being, or forming, the other part of the "valve mechanism."

In using the term "valve mechanism" I used it to designate the device as an entirety, and as I proceeded I used the term "triple valve proper" to designate a part of the entire device, as the "triple valve proper" is a distinct part of the device. I then proceeded to describe the other parts of the device, the whole forming the complainants' quick-action triple valve.

Objected to by counsel for complainants as not responsive.

X 46 Q. You "first started" answer six with the clause: "This is a valve mechanism used in automatic air brakes, the functions of which are;" (the punctuation being as I have given it) and immediately thereafter recited functions 1st, 2d, 3d and 4th.

Now I again ask you to indicate specifically, for the information of the court, what, if any, portion of the language used by you when you "first started" answer six (being the *only* language used by you prior to your recital of said functions, 1st, 2d, 3d and 4th), which would, in your honest opinion, indicate to any intelligent human being that you intended to recite said functions, 1st, 2d, 3d and 4th as being, not the functions of the "valve mechanism,"
863 i. e., the entire thing, structure or device inquired about, but as being the functions of some selected portion or portions thereof called by you the "triple valve proper."

Defendants' counsel again protests against this line of cross-questions, as a mere waste of time on verbal quibbles, and a gross abuse of the privilege of cross-examination.

Counsel for complainants suggests that cross-examination is not a "privilege," but is a *right*, which he proposes to exercise with the full recognition of his duty to the court and to his clients.

Defendants' counsel rejoins that the law gives no right to ask immaterial questions, and to repeat them for days after their immateriality has been pointed out.

Counsel for complainants rejoins that the immateriality of questions is a matter for the determination of the court, and not one to be settled by the *dictum* of either counsel.

A. I have endeavored to answer the cross-questions intelligently, truthfully, and with candor, as I have no object to deceive the court or any one else. I have several times defined the term "valve mechanism" and what I meant by it, and I will again reiterate it.

Counsel for complainants here interrupts the witness and calls his attention to the fact that the question does not ask anything about the meaning of the term "valve mechanism" or of any other term, but simply asks him to point out to the court any portion or portions of a certain quoted passage of his testimony which would, in his opinion, convey to a reader the understanding that he meant to recite functions 1st, 2nd, 3rd and 4th as being merely the functions of the "triple valve proper."

Defendants' counsel objects that if the witness' answer 6, taken as an entirety, points out the fact referred to by complainants' counsel, it is all that is necessary; and that there is no law requiring
864 that that distinction should be stated in some particular clause of the answer, that the complainants' counsel chooses to select; and that answer 6, when read as a whole, *does* make the witness' meaning absolutely clear.

Counsel for complainants renews his objection and protest, and submits to the court that the witness' failure to fully answer the questions put to him in cross-examination has been largely due to

is endeavor to follow the suggestions embodied in defendants' counsel's objections.

(The witness resumes his answer as follows:)

It means the entire structure, which includes "the essential features of the device are, 1st, the triple valve proper, containing efficient valves to make it perform the triple-valve functions, and second, an additional or auxiliary valve to admit the main air-pipe pressure directly to the brake-cylinder."

In using the term "valve mechanism" I did not intend it to mean only the triple valve proper, or the auxiliary valve, or any other special part of the device, and therefore, it is not intended to convey the meaning of any special part or parts of the complainants' quick-action triple valve.

Objected to by counsel for complainant-as wholly irresponsible.

X 47 Q. Is this the best answer which you can or will make to cross-question 46?

A. This is the best answer I can make to cross-question 46.

Recess.

X 48 Q. After having recited, in the first paragraph of your answer 6, what you denominated the "1st," "2nd," "3rd" and "4th" functions of the "valve mechanism" you are describing, you say:

"These four valves form what is commonly known as a triple valve proper," and as used in the art prior to 1887," (having thus far in your answer made no mention whatever of the function of effecting the admission of air directly from the main air pipe to the brake-cylinder.)

Now, will you, as a mechanical engineer and air-brake expert, pretend to deny either of the three following statements of facts, to wit:

(a) That the alleged function of the valve mechanism of patent No. 360,070, which you have recited as "3rd, to admit auxiliary reservoir air to the brake-cylinder through the valve port 35 by the normal movement of the piston 12," has nothing whatever to do with a triple valve proper, and as used in the art prior to 1887."

(b) That said alleged function "3rd" has nothing whatever to do with, and is not performed by, the valve mechanism of patent No. 360,070, when operating as "a triple valve proper and as used in the art prior to 1887;" that is to say, when said valve mechanism is *not* operating to effect the admission of air directly from the main air pipe to the brake-cylinder.

(c) That said alleged function "3rd" is distinctly and specifically recited in patent No. 360,070 as being performed when the piston 12 arrives at the extremity of its stroke, in effecting the admission of air directly from the main air pipe to the brake-cylinder, patent, lines 43 to 51, page 4,) and that there is neither statement, hint, nor suggestion, in patent No. 360,070, of such a function being performed *under any other circumstances or conditions.*

Please answer statements (a), (b) and (c) severally.

A. As to statement (a) I do deny that statement, because in the art prior to 1887 triple valves were provided with two valves to admit the air from the auxiliary reservoir to the brake-cylinder, as is shown in patent to Westinghouse, No. 220,556, patented Oct. 14th, 1879. In this patent of 1879 is found a graduating valve (c'), which admits air from the auxiliary reservoir 866 to the brake-cylinder. This graduating valve is operated by the first movement of the piston and is actuated by a slight variation of air pressure in the main air pipe. This patent of 1879 also provides for admitting air from the auxiliary reservoir to the brake-cylinder by another valve, which valve is formed by the upper end of the slide-valve II. This valve II is opened by the final movement of the piston, and by a greater reduction of the pressure of air in the main air pipe than is required to manipulate the action of the graduating valve. Therefore, I find in patent No. 220,556 a valve (main valve II) corresponding to the valve formed by the port 35 in complainants' quick-action triple valve. In both the 1879 patent and the complainants' quick-action triple valve these valves perform the same functions and both are opened by the final movement of the piston.

I also deny statement (b), as my understanding of the complainants' quick-action triple valve is that in case the brakes were to be applied fully by the auxiliary reservoir pressure alone the engineer's valve would be placed in a position to continuously and gradually discharge the air from the main air pipe. This continued gradual discharge of air would *finally* move the piston its full stroke, and, in such an event, that air which passes from the auxiliary reservoir to the brake-cylinder would partly be supplied through the port 35.

Another instance in which this port 35 would perform a function of the triple valve proper is that if the hose connection would accidentally rupture or disconnect between the cars, the air from the main air pipe would be instantly exhausted under that car, or the pressure sufficiently lowered at that car, to prevent the main air-pipe pressure from going to the brake-cylinder, although the auxiliary valve would be open. In this event the air from the auxiliary reservoir would pass to the brake-cylinder through the valve formed by the port 35, and thereby perform the triple-valve function, when no air was admitted to the brake-cylinder from the main air pipe.

867 As to the statement (c), it is my understanding that patent 360,070 nowhere states that the valve formed by the port 35 performs the function of a triple valve except when producing quick action, therefore I agree with you in statement (c).

X 49 Q. Briefly stated, then, *you* do deny the correctness of statements (a) and (b) of cross-question forty-eight and admit the correctness of statement (c)?

A. Yes.

X 50 Q. Prior to the year 1887 what, if any, actual, personal and practical knowledge of, or experience in, the art as relating to air

brakes, had you? Please state fully the nature and extent of such knowledge, and experience, if any?

A. In 1883 I took out my first patent in air brakes, and from that time I began studying and investigating the air-brake subject. About 1885 I designed the spring and air brake especially for freight cars, as I at that time realized that in the near future freight cars would require power brakes. I had not got far in the spring and air brake before I realized that means would have to be provided to deplete the main air pipe of its pressure more rapidly than could be done by the engineer's valve. Therefore I designed a valve to deplete the main air-pipe pressure under each car, and afterwards put a valve of this character in practical operation on a test train of the B. and O. railroad. In the spring of 1887, prior to going to the Burlington brake test, I called Mr. C. B. Mann's attention to the fact that I could convert the valve device shown in my 1883 patent into a quick-action triple valve.

He encouraged me in this, stating that it might be likely we should want to go into the air-brake business after the expiration of the Westinghouse automatic patents.

X 51 Q. Prior to the year 1887 what, if any, actual practical or personal knowledge of or experience in the art as relating to triple valves for automatic air brakes had you?

868 A. Not any, except that I constructed a valve the same as my 1883 patent and tried it.

X 52 Q. Then I understand that your view as to "a 'triple valve' proper and as used in the art prior to 1887," expressed in your present deposition, are based merely upon your reading and study and not upon any actual knowledge of or practice with triple valves for automatic air brakes existing prior to 1887?

A. You are correct.

X 53 Q. And I also understand that you cite the Westinghouse patent No. 220,556 as fairly representing the essential features of "a 'triple valve' proper, and as used in the art prior to 1887," and as supporting the correctness of your statements as to the operation and functions of such triple valve proper.

A. Your understanding is correct.

X 54 Q. In your answer to cross-question forty-eight you say (referring to patent No. 220,556):

"In this patent of 1879 is found a graduating valve (*e'*) which admits air from the auxiliary reservoir to the brake-cylinder. This graduating valve is operated by the first movement of the piston, and is actuated by a slight variation of pressure in the main air pipe. This patent of 1879 also provides for admitting air from the auxiliary reservoir to the brake-cylinder by another valve, which valve is formed by the upper end of the slide-valve H. This valve H is opened by a final movement of the piston, and by a greater reduction of the pressure of air in the main air pipe than is required to manipulate the action of the graduating valve."

Your views as to the triple valve of patent No. 220,556 being, as admitted in your answer to cross-question fifty-two, based merely upon your reading and study, and not upon actual knowledge of or

practice with triple valves, prior to 1887, please quote upon the record fully for the information of the court any passage or passages of the specification of patent No. 220,556 which you understand provides for the admission of air from the auxiliary reservoir to the brake-cylinder by a valve other than the graduating valve,

869 as you have alleged in the portion of your answer to cross-question forty-eight, above quoted by me?

A. I do not find in the specification any mention made of the admission of auxiliary reservoir air to the brake-cylinder by the main valve H, but it is perfectly obvious to any one who is familiar with reading drawings that the upper end of the valve H can pass to the lower side of the port C leading to the brake-cylinder. This is made plain by measuring the full stroke of the piston and comparing that measurement with the distance from the upper end of the valve to the lower side of the port C, leading to the brake-cylinder. The opening of this valve would occur in case the hose connections between the cars should burst, or a large amount of main air-pipe air would be discharged at the engineer's valve by the engineer in case it was desired to fully apply the brake in case of an accident or otherwise, as by the opening of the valve H the air could pass from the auxiliary reservoir to the brake-cylinder much quicker than if passing through the graduating valve, the whole structure being intended to operate this way, and would operate this way, when the brakes were to be applied with their full force as quickly as possible.

All of the foregoing answer subsequent to these words "the main valve H," in the first clause thereof, objected to by counsel for complainants as not responsive and a mere volunteer statement.

Adjourned to Wednesday, May 3d, 1893, at 10 o'clock a. m.

The same parties met on May 3d, 1893, at 10 a. m., pursuant to adjournment, and proceeded as follows:

X 55 Q. Please quote any passage of patent No. 220,556 which states, either directly or in substance, that the valve H of said patent is opened by a final movement of the piston and by a greater reduction of the pressure of the air in the main air pipe than

870 is required to manipulate the action of the "graduating valve," as is alleged by you to be the case in your answer forty-eight.

A. I did not state that there was any passage or lines in the specification which stated that the valve H admitted air from the auxiliary reservoir to the brake-cylinder, or that the specification contained a passage or lines in which it was stated that the valve was opened by the final movement of the piston, but I did assert that such was the case in reality, and I think any one who is familiar with patents and patent drawings would agree with me, as it is evident that if the piston was moved its full stroke the valve H would be moved to uncover the port C, and thereby admit the air from the auxiliary reservoir to the brake-cylinder in a greater volume than it could be admitted by the graduating valve. I am

thoroughly satisfied that persons who handle the brake practically will agree with my view, and I am satisfied that counsel for complainants knows that my assertions as to how the valve II operates are correct.

In further proof of my statement being correct I will refer to the Westinghouse catalogue of 1886, (see stipulation complainants' printed record, page 231.) and call the attention of the court to the 4th line, which pertains to applying the brakes with the slide-valve of the 3rd paragraph, page 10. "As the piston descends, it moves with it the slide-valve 6," (slide-valve II in patent,) "so as to permit air to flow *directly* from the auxiliary reservoir to the brake-cylinder which forces the piston out and applies the brakes;" and also to lines 11 to 17, both inclusive of the same 3rd paragraph, which lines pertain to applying the brakes gently through certain passages or openings in the slide-valve, which are opened and closed by a small valve 7, [the graduating valve (c)] of the patent No. 220,556.

Objected to by counsel for complainants as not being in the slightest degree responsive to the question.

X 56 Q. In your answer 48 you did not say anything about what was the case in reality, or what you supposed would be the case in reality, but what you *did* say was: "In this patent of 1879 (patent No. 220,556) is found a graduating valve (c'), which admits air from the auxiliary reservoir to the brake-cylinder. This graduating valve is operated by the first movement of the piston and is actuated by a slight variation of air pressure in the main air pipe. This patent of 1879 also provides for admitting air from the auxiliary reservoir to the brake-cylinder by another valve, which valve is formed by the upper end of the slide-valve II. This valve II is opened by the final movement of the piston, and by a greater reduction of the pressure of air in the main air pipe than is required to manipulate the action of the graduating valve."

Now, will you please indicate, if you can, any portion of the specification of patent No. 220,556 which states, either directly or in substance, that the valve II is opened by the final movement of the piston, and by a greater reduction of the pressure of air in the main air pipe than is required to manipulate the action of the graduating valve?

A. I do not find any paragraph, passage or line in the printed specification which refers to the above, but the drawing unmistakably discloses or shows that my statement in answer to question 43 is true.

All of the foregoing answer after the first clause thereof objected to by counsel for complainants as not responsive and is a mere volunteer statement.

X 57 Q. Then, if I understand you correctly, the statements made by you in answer 48 as to patent No. 220,556 and quoted by me in cross-questions 54 and 56 are not based upon anything whatever that is recited in the specification of said patent, but are merely

statements of your opinion based upon your reading and study and not upon any practical knowledge of or experience in the use of triple valves similar to that set forth in patent No. 220,556. Am I correct?

A. You are partly correct, inasmuch as the printed specification does not mention the action of the valves as mentioned by you under discussion, but as the printed specification is only part of the patent and the drawing another part, it is perfectly permissible to read from either drawing or printed specification, as together, they form the description of the patent.

In one of my preceding answers I stated that I had no practical experience with triple valves prior to 1887, but since that time I have had considerable practical experience. Therefore, I now interpret the patent from its drawing based upon what I actually know about triple valves. It is customary to refer to the drawing for information that the printed specification does not give, or *vice versa*. As the specification in the patent No. 220,556 does not mention how and when the valve II is opened, I have used the drawing therein to determine, and I am sure the device operates just as I have stated.

X 58 Q. What, if any practical knowledge of or experience in the use of triple valves, similar to that set forth in patent No. 220,556 have you had either before or after 1887?

A. I have had valves which were made in exact accordance with patent No. 220,556 at our shop, the works of the Boyden Brake Company, where I have operated them in various ways in connection with the valves made by the Boyden Brake Company, thereby becoming perfectly familiar with their operation. I have, also, experimented with trains on the B. and O. railroad, and the B. and O. Southwestern railroad partly made up with cars equipped with brakes having Westinghouse triple valves the same as in patent No. 220,556 and partly made up with cars equipped with our triple valve, and in these experiments I have learned that the Westinghouse triple valve shown in patent No. 220,556 operates as I have stated.

X 59 Q. How many valves which were made "in exact accordance with patent No. 220,556," did you have at your shops, how many of them did you operate, and in what manner did you operate them?

A. I don't think I had more than two at any one time.
873 I have operated them by themselves and in connection with valves made by us. These operations were made on a testing rack at our works by operating the graduating valve, and thereby intermittingly applying the brakes with a slight reduction of main air-pipe pressure; and by operating them to open the port governed by the main valve II by a considerable reduction of main air-pipe pressure.

This last operation would more quickly apply the brakes than could be accomplished by the use of the graduating valve (*c'*) alone.

X 60 Q. When you say in answer 48 (referring to patent No. 220,556), "This valve II is opened by the final movement of the

piston, and by a greater reduction of the pressure of air in the main air pipe than is required to manipulate the action of the graduating valve," you mean, I suppose, opened "so as to uncover the port C," and would be satisfied to have your answer to question 48 read as if the words last quoted were included. Am I correct?

A. You are.

X 61 Q. And I understand that you believe an operation of the triple valve of patent No. 220,556, in which the valve II is opened (so as to uncover the port C) by the final movement of the piston, and by a "greater reduction of the pressure of air in the main air pipe than is required to manipulate the action of the graduating valve," to be an *intended*, and, in practice, a *normal* operation of the valve set forth in patent No. 220,556. Am I correct?

A. You are.

X 62 Q. Such being your belief, I presume you also believe and assert that this supposed function of the triple valve of patent No. 220,556, *i. e.*, the operation recited in the last preceding question, would be performed by all of the several triple valves of a train of, say 20 or 25 cars, each equipped with a triple valve similar to that of patent No. 220,556 and with the proper connections, whenever what you term in answer 48 "a greater reduction of the pressure of air in the main air pipe than is required to manipulate the action of the graduating valve," is made by the engineer of the train. Am I correct?

A. In a case of this kind I should say the operation would be about as follows: Supposing it was desired to stop the train as quickly as possible, the engineer would place the engineers' valve in a position to fully exhaust the main air-pipe pressure to the atmosphere. This sudden and full exhaust would move the pistons of the triple valves of the first cars the full stroke and thereby open the valves II to uncover the ports C in such valves.

However, in an action of this kind I think the pistons of the triple valves of the rear cars would not move their full stroke simultaneously with those of the first cars, owing to the fact that the pressure in the main air pipe would not be so quickly and fully exhausted at the rear end as at the front end. I have never tried this experiment on a train of 20 or 25 cars to see what would be the actual effect on the rear cars.

X 63 Q. I do not clearly understand from your answer whether or not you believe and assert that the operation recited in cross-question 61, would be performed by *all* of the several triple valves of a train of say 20 or 25 cars, under the conditions recited in cross-question 62.

To make the matter perfectly clear to the court and to me, please state whether or not, you believe and assert that said operation would be performed by *all* of said triple valves, under said conditions?

A. I have stated in my last preceding answer that I considered that only the valves on the first cars, say ten cars, would have the valves II opened to uncover the port C, therefore *all* of the valves

H would not fully uncover the port C, simultaneously with the front ones.

X 64 Q. Do you believe and assert that, under the conditions as recited in X Q. 61 and 62, the valves H of the triple valves of the cars at and towards the rear of the train, or succeeding those of, say the first ten cars, would be opened so as to uncover the ports C at all?

A. Yes, I believe the valves H would ultimately open the
875 ports C on all the cars, which opening would take place when the pressure in the main air pipe would be sufficiently exhausted.

Recess.

X 65 Q. It is the fact, is it not, that this ultimate opening of the ports C, by the valves H, of the triple valves on the cars at and towards the rear of the train, stated in your answer 64, would not, and *could* not, be effected, until the pressure in the main air pipe had been sufficiently reduced to become less than the equalized pressure in the auxiliary reservoirs and brake-cylinders of said cars at and towards the rear of the train?

A. It is a fact, to just what degree I am unable to state.

X 66 Q. Is it not the fact, unqualifiedly?

A. I should say it was on some of the cars.

X 67 Q. You mean by that, I suppose, on the cars at and towards the rear of the train, but cannot say on how many of said cars. Is this the fact?

A. Yes.

X 68 Q. And, it is, also, the fact, is it not, that this ultimate opening of the ports C by the valves H of the triple valves on the cars, at and towards the rear of the train, would not have any effect, whatever, in admitting air from the auxiliary reservoirs to the brake-cylinders through said ports C, for the reason that air had been already admitted from the auxiliary reservoirs to the brake-cylinders and the pressures in said auxiliary reservoirs and brake-cylinders had been equalized, as a necessary preliminary to the downward traverse of the pistons which effected the opening of the ports C by the valves H?

A. I should say it would be the fact on a train of the length of 25 cars.

X 69 Q. A train of 20 or 25 cars is not, and was not in 1879 a train of any extraordinary or unusual length in railroad service, was it?

876 A. No; and I think that at that time I would be safe in stating that there were very few, if any, freight cars equipped with air brakes to be used in freight service.

X 70 Q. There were, at that time, very many passenger cars equipped with air brakes to be used in passenger service, and, in many cases, these trains consisted of 8, 10 and 12 cars. I mean by passenger cars, cars used on passenger trains, including baggage, mail, express, dining and sleeping cars. Am I not substantially correct?

A. You are.

X 71 Q. From your description of the operation of the triple valves of patent No. 220,556, as given in answer 62, and from your succeeding answers, I understand you to admit that in a train of, say 20 or 25 cars, the operation of *admitting air* from the auxiliary reservoirs to the brake-cylinders by the opening of the valves H, so as to uncover the ports C, would be effected on the first cars of the train, and would *not* be effected on the cars at and towards the rear of the train. Is this correct?

A. Yes, that is my understanding of the matter.

X 72 Q. And this would, also, be substantially the case, would it not, on trains of a less length than 20 or 25 cars?

A. No, it would not on a train, say of 10 or 12 cars.

X 73 Q. Do you make this last statement as a matter of absolute and personal knowledge, or do you state it merely as a matter of opinion?

A. It is both; I have never tried it practically on a train, but I have tried it in the factory with about 10 brake-equipments connected as in practice, and the time it required to exhaust the main air-pipe pressure was such that I am satisfied that the triple valves on the last cars would be effected sufficiently great for the valve H to uncover the port C soon enough to admit the auxiliary reservoir pressure to the brake-cylinder through the port C.

X 74 Q. I got the idea from your preceding testimony that you never had more than *two* triple valves similar to the triple
877 valve of patent No. 220,556 at your factory or works. Am I right as to this?

A. Yes, you are right. The test I referred to in the preceding answer was made with valves manufactured by us.

X 75 Q. Were these triple valves that were manufactured by you similar to the triple valve of patent No. 220,556?

A. Yes, in the mode of operation, but the form was different. The valves I used were the same as defendants' quick-action triple valve, with the bushing 9 removed, so that they could not admit main air-pipe air to the brake-cylinder.

X 76 Q. Then, so far as triple valves, the same as the triple valve of patent No. 220,556 are concerned, if I understand you correctly, you never tried any experiment in operating them in connection with the brake-equipment of a train of 25 cars, 20 cars, 10 cars or any other number greater than two. Am I correct as to this?

A. You are.

X 77 Q. In such an operation of the triple valves of patent No. 220,556, as is recited in your answer 62 and in your subsequent answers, that is to say, in which air is admitted from the auxiliary reservoirs to the brake-cylinders, by the opening of the valves H so as to uncover the ports C, on the *first* cars of the train, and is *not* admitted from the auxiliary reservoirs to the brake-cylinders by the opening of the valves H, so as to uncover the ports C, on the cars at and towards the *rear* of the train, the result would be, would it not, to effect a comparatively quick and powerful application of the

brakes on the *first* cars, and a comparatively slow and light application of the brakes on the *rear* cars?

A. No, you are not entirely right according to my understanding.

The braking power or force applied would be alike on all the cars, but those on the first end would receive the power in a less space of time than the cars on the rear end of the train. This

would be due to the brakes being applied to the cars on the 878 front end of the train by the valve H opening the port C, whereas those on the rear end of the train would be applied by the graduating valve, as the ports of the graduating valves are much smaller than the ports C uncovered by the main valves.

The brakes would be applied on both ends of the train by the full reservoir pressure, therefore the braking force will be the same.

X 78 Q. I, somehow or other, got the idea, from your testimony, that you held and asserted a theory to the effect that the triple valve of patent No. 220,556 and the triple valve of patent No. 360,070, for that matter, were devices, each of which had two different *designed* and *normal* functions, one being to effect a "partial" application of the brakes by the admission of reservoir pressure through the port controlled by the graduating valve, and the other, to effect a "full" application of the brakes through a port controlled by the slide-valve.

In view of your last preceding answer, in which you state that "the brakes will be applied on both ends of the train by the full reservoir pressure, therefore the breaking force will be the same," it seems to me that I must be mistaken.

Please state whether or not I am correct as to the view or theory I supposed you to hold?

A. You got exactly the theory I wish to convey, that the Westinghouse triple valve of patent No. 220,556 and the triple valve proper of complainants' patent No. 360,070 both performed normally the function of admitting auxiliary reservoir pressure to the brake-cylinder, 1st, by the graduating valve, and 2d, by the main valve (designated by the letter H in patent No. 220,556, and formed by the port 35 in the patent No. 360,070.)

You then asked the question, pertaining to a train of 25 cars, how the triple valve would act in this case which I answered, and, I believe, answered correctly; but the fact that the triple valve of patent No. 220,556 operated as I have stated on a train of 25 cars is no proof that it would not act on a short train of 5 or 10 cars, as

I stated in my preceding answers.

879 X 79 Q. I still fail to reconcile your novel and ingenious theory as to the triple valves of patents Nos. 220,556 and 360,070 with your answer to cross-question 77.

You have admitted that the brakes would be applied on the *first* cars of a train such as we were talking about, as say 20 to 25 cars, by the admission of reservoir pressure to the brake-cylinders through the ports C controlled by the valves H, and that in the *rear* cars of the train the admission of reservoir pressure to the brake-cylinders

would *not* be effected by the opening of the ports C by the valves H. Under such conditions you say, in answer to X Q. 77, that "the brakes will be applied on both ends of the train by the full reservoir pressure, therefore the braking force will be the same."

Now if the braking force is the same when the reservoir pressure is admitted through the ports C, when opened by the valves H, and when the reservoir pressure is *not* admitted through said ports when opened by the valves H, but is admitted through the ports controlled by the graduating valves (*e'*), as in your stated operation of the train we have been talking about, will you please explain how, if at all, your theory of "full" and "partial" applications of the brakes applies, if your answer to X Q. 77 be correct, that is, if, as stated therein, "the same braking force" is exerted with the members of some of the triple valves in position for the "full" application of the brakes of your theory and with the members of some of the other triple valves in position for the "partial" application of the brakes of your theory?

A. It is true that the full reservoir pressure can be admitted to the brake-cylinders by either the graduating valve or through the ports C, when uncovered by the main valve H, the difference being that the air, when admitted to the brake-cylinder through the large port C, when uncovered by the valves H, would take a less space of time to equalize in the auxiliary reservoir and brake-cylinder than when passing through the small ports of the graduating

880 valve. Therefore the only difference in a 20 or 25 car train would be the time consumed in admitting the air from the auxiliary reservoir to the brake-cylinder by the two valves respectively when making a full application of the brakes. In case the brakes were to be applied gradually and partially the engineers' valve would be manipulated in such a manner that the graduating valves only throughout the 25 cars would be brought into action, thereby partially applying the brakes. Therefore this would be an illustration of the *partial* application of the brakes, in distinction to a *full* application of the brakes in as quick time as possible.

X 80 Q. If the only difference between the two applications of your theory be that of "time," as I understand from your last preceding answer, would not what you denominate the "full" and "partial" application, respectively, be more accurately designated as the "quick" application and the slower gradual application, inasmuch as you say that the "full reservoir pressure" will be applied on both ends of the train?

A. In considering the action as applied to a 20 or 25 car train, I should say it would be correct. My understanding of the graduating valve and its function is, that with the graduating valve the brakes can be more slowly applied, and the application of the brakes graduated to a nicety, as the case may require. Therefore, I drew the distinction between it and the main valve by terming its action a *partial* application of the brakes, whereas I defined the *full* application of the brakes by the main valve, as it, when brought into operation, would fully apply the brakes with the reservoir pressure in the quickest possible time.

Adjourned to Thursday, May 4th, 1893, at 10 o'clock a. m.

On Thursday, May 4th, 1893, at 10 o'clock a. m., same parties met, pursuant to adjournment, and proceeded as follows:

881 X 81 Q. In such an operation the triple valves of patent No. 220,556, as is recited in your answer 62, and in your subsequent answers, that is to say, in which air is admitted from the auxiliary reservoirs to the brake-cylinders, by the opening of the valves H so as to uncover the ports C, on the *first* cars of the train, and is *not* admitted from the auxiliary reservoirs to the brake-cylinders by the opening of the valves H, so as to uncover the ports C, on the cars at and towards the *rear* of the train, the result would be, would it not, to effect a comparatively quick application of the brakes on the *first* cars, and a comparatively slow application of the brakes on the *rear* cars?

A. Yes; that is my understanding of it.

X 82 Q. And that result would be a detrimental and injurious result as was demonstrated at the Burlington trials, most conclusively, by reason of the great shocks occasioned on the first cars of the train; am I not correct?

A. You are correct in regard to the fifty-car-train test; but my recollection is, that on the 25 car-train test the valves worked fairly satisfactory, although they would not work as well on a 25-car train as on a train, say, of about 10 cars.

X 83 Q. Regardless of the length of the train would not any operation of the triple valves in which the brakes were applied quickly to the *first* cars, and slowly to the *rear* cars, that is to say, in the manner as recited in your answer 62, be an objectionable, injurious and undesirable operation in practical railroad service?

A. I should say it would be on a train consisting of not less than 20 cars or more than 20. The longer the train the more serious the results would be, owing to the tardy action of the rear brakes which would permit the rear cars to butt the forward cars that had the brakes applied promptly. I should say, however on a train consisting of ten cars, such as are used in passenger service, there would be no serious or bad result.

My understanding is that the triple valve shewn in patent 882 No. 220,556 gave entire satisfaction in passenger service, and in such service the valves operated as I stated in my sixth answer. However, when these same valves were put in use in freight service on long trains, it was discovered that their action was entirely too slow on the rear of the train. Therefore while they were entirely satisfactory in passenger service they were not at all in freight service.

X 84 Q. I fully agree with you, and I do not see how any one familiar with air-brake practice could differ with you, that the greater the length of the train, the *worse* would be the result of a quick application of the brakes on the *first* cars, and a slow application of the brakes on the *rear* cars.

Now wholly regardless of the length of the train on which such an application was made, would not such an application be objectionable, injurious and undesirable in railroad practice?

A. On a train of more or less length you are correct.

X 85 Q. Would such an application of the brakes, in your opinion, be a proper, advantageous, desirable or correct one on a train of *any* length?

A. Theoretically it would not. Practically, so far as injurious results are concerned on a short train, say of 3, 4 or 5 cars, I don't think there would be any particularly bad results follow.

X 86 Q. Is such a mode of application of the brakes, that is to say, a quick application on the *first* cars and a slow application on the *rear* cars, believed by you to be correct and advisable practice, and are the triple valves manufactured by your company so organized as to effect such an application?

A. No, it is not a desirable practice, nor are the triple valves manufactured by us made to operate that way.

X 87 Q. Now, inasmuch as I understand you to admit that there is not a word of statement or suggestion in patent No. 220,556 that the triple valve of said patent operates to admit reservoir air to the brake-cylinder by the opening of the port C by the valve H; of your further admission that if so operating on a train of say
883 20 or 25 cars the brakes would be quickly applied on the *first* cars, and slowly applied on the *rear* cars, and of your further admission that on a train of more or less length such an application of the brakes would be objectionable, injurious and undesirable, I would like you to state to the court, if you can, what your reason is for assuming and stating as you have done, that the admission of reservoir pressure to the brake-cylinder by the opening of the port C by the slide-valve H, is a *normal* and *intended* function of the triple valve of patent No. 220,556?

A. This question assumes that I have admitted more than I did, that is to say, several of your preceding questions are in the abstract based on a theory that the valves *did* operate differently on the front and rear end of the train.

Counsel for complainant- interrupting the witness, calls his attention to his answer 62 in which he stated that they did so operate.

Witness continuing says: When I was interrupted by the counsel for the complainants, I was about to state that the valves would act different on a train, say, consisting of 25 cars, in which the brakes on the *first* cars would be applied with full force quicker than those on the *rear* end; but I did not admit that this would be the case in practice on a short train of, say, 5 or 10 cars, such as are used in passenger service. Now as the triple valves shewn in patent 220,556 were designed for passenger cars, and to be used on comparatively short trains, they worked satisfactorily when used as such. In this service of short trains the graduating valves would *normally* operate to admit the air from the auxiliary reservoir to the brake-cylinder when a graduated application of the brakes was desired, but when it was desired to fully apply the brakes as quickly as possible, then the slide-valves H would uncover the port C, and *they* would *normally* admit the auxiliary reservoir air to the brake-cylinder.

When these valves were put on freight cars to be used in long trains it was discovered that the graduating valve (*e'*) and the main valve II did not operate in their normal capacities as they did on short trains.

This led to the invention of rapidly depleting the main air pipe of its pressure in order to make the graduating valve (*e'*) and main valve II operate in their normal way. It is my opinion that this rapid depletion of the main air-pipe pressure was first suggested by Mr. George Westinghouse in 1879, as is shown by patent No. 217,838, dated July 22d, 1879; the object of this invention being to make the triple valve, shown in patent No. 220,556, operate in its *normal* way on long trains as it did and was intended to operate on short trains, and as explained by me in my 6th answer.

Objected to by counsel for complainants as being wholly irresponsible, and as being merely an unasked-for rambling argument as to the quick-action invention.

X 88 Q. Is this the best answer that you can or will make to the request of cross-question 87, that in view of your admissions therein stated you will give your reason for assuming something that is neither mentioned nor suggested in patent No. 220,556 to be a *normal* and *intended* function of the triple valve of said patent.

A. That is the best answer that I can give, as I believe the facts which I stated are true.

X 89 Q. In view of the opening clause of your answer to X Q. 87 I now ask you to indicate specifically to the court anything whatever in that question which assumes one iota more than you have distinctly and squarely admitted?

A. Your question 87 relates in part to a train of "more or less length," and then asks me to explain to the court how "the opening of the port C by the slide-valve II is a normal and intended function of the triple valve of patent No. 220,556." Therefore, I think, you wish to imply that a train of more or less length includes a short train of, say from 5 to 10 cars, and that in a train of this kind the valve II would have no normal function. This is what I meant when I said in my last answer to you, that your question "assumes that I had admitted more than I did."

Objected to by counsel for complainants as wholly irresponsible.

X 90 Q. Cross-question 89 asks you nothing whatever about what X Q. 87 "relates" to or what it "asks," but is strictly limited to what you say it "assumes."

Now, I again ask you to indicate specifically to the court anything whatever in X Q. 87 which assumes one iota more than you have distinctly and squarely admitted, and by this I mean I want you to quote to the court upon the record any portion of the language of X Q. 87 which you say or believe so "assumed."

A. The interpretation I put on the question was based on the assumed fact that the valve II, under no condition, would normally admit the auxiliary reservoir air to the brake-cylinder, and as this is *not* my understanding of the operation of the valve II I supposed

you wanted me to admit that such was not the fact. Therefore, my statement, in which I said you "assumed" certain things, was based on my interpretation of the question more than on the language you used.

Same objection.

X 91 Q. Will you, or will you not, quote to the court upon the record the portion of X Q. 87 which you think makes the "assumption" alleged by you in the first clause of your answer to that question?

A. As I before stated, I based the statement pertaining to what you "assume" on my interpretation of the question, and not on the language you used. Therefore, I am unable to quote any passages called for by your question to the supposed assumption.

X 92 Q. Now, will you not fairly and squarely say that in X Q. 87 I did not assume that you had admitted one iota more than you *did* admit?

A. Yes, I will; but I want it understood that when speaking of a train of more or less length it was in the abstract, and while discussing the matter of the action of the triple valves on a train of more or less length the valves would operate differently on the front and rear of the train; but on a short train, such as a passenger train, the graduating valve would have a normal action and also the main valve would have a normal action.

X 93 Q. You say in answer 87 "that the triple valves of patent No. 220,556 were designed for passenger cars and to be used on comparatively short trains." Do you find any warrant in the patent for this statement, and, if so, where?

A. No; I do not.

X 94 Q. Have you any actual and personal knowledge that in actual practice in railroad service the triple valves of patent No. 220,556 were normally operated to admit reservoir pressure to the brake cylinder by the opening of the port C by the valve II. If so, how, when and where was such knowledge acquired?

A. What practical knowledge I have of the triple valve shown in the patent No. 220,556 consists, principally, of the knowledge I gained of its action when I was experimenting with the triple valve used by us on the B. and O. railroad. In some of these experiments we would connect cars equipped with the Westinghouse brake, which equipment contained valves like those shown in patent No. 220,556, in order to see how our brakes would work with the Westinghouse. In these tests I noticed that when the air would be intermittently discharged by the engineer's valve that the brakes would gradually and partially apply, but if the pressure from the main air pipe was rapidly discharged by the engineer's valve the brakes would more quickly apply than when using the graduating valve. I have, also, at our factory made numerous experiments with the Westinghouse triple valve, as shown in patent No. 220,556, in which I always found the Westinghouse triple valve shown in the patent No. 220,556 to operate as I have stated in my answer 6.

X 95 Q. In these experiments at your factory, I understand from your previous testimony, that you only used two triple valves like that shown in patent 220,556? Is that correct?

887 A. Yes.

X 96 Q. Were the experiments and tests on the B. and O. railroad which you have referred to in answer 94 conducted by you or under your direction?

A. They were.

X 97 Q. Were they made in the ordinary running of the train in regular service or was the train merely put at your disposition by the B. and O. officers for experimental purposes, and used by you experimentally only?

A. The train was first put at my service for experimental purposes, and it was then that I made the experiments mentioned, although it was put in regular service afterwards, and I would frequently travel with it, but it was not then under my control.

Recess.

X 98 Q. How many triple valves like that of patent No. 220,556 were used on the B. and O. train during your experimental use thereof, and do you know, from personal examination, that all of these triple valves were similar to that of patent No. 220,556?

A. My recollection is that there were about two or three cars with the Westinghouse brake on them in the train. I personally examined the valves on the outside only; I did not take them apart.

X 99 Q. You are not able to say, then, of your own knowledge that the two or three Westinghouse triple valves used on this experimental train were constructed the same as the triple valve of patent No. 220,556?

A. My judgment was based on the outside form of the valve casing, which conformed exactly to those I had in our factory, and which I made the experiments with there. Therefore, I am satisfied they were the same as shown in patent No. 220,556.

Answer objected to by complainants' counsel as not responsive.

X 100 Q. X Question 99 repeated.

A. I did not take the valve apart to examine it.

888 X 101 Q. That being the case, you, therefore, do *not* know, of your own knowledge, that these two or three Westinghouse triple valves were constructed the same as the triple valve of patent No. 220,556? Is this the fact?

A. While I did not take the valves apart to examine them, I am satisfied they were the same from their outside form.

Objected to by complainants' counsel as not responsive.

X 102 Q. Do you or not know, of your own knowledge, whether the two or three Westinghouse triple valves of the B. and O. railroad experimental train were constructed the same as the triple valve of patent No. 220,556?

You will save unnecessary delay in cross-examination if you will refrain from repeating your conjectures, ideas, or belief about these

valves, and will simply give what is asked for, namely, a statement of your own knowledge about them.

Objected to by counsel for defendant- as useless and vexatious repetition of a question already fully answered by the witness fully stating the facts to the court. The present question is apparently based on the incorrect assumption that there is only one source of human knowledge, and that is through the eye.

Counsel for complainants replies, that while it is perfectly competent for the witness, being an expert, to give statements of opinion when asked for, that capability does not excuse him from answering questions as to *facts* when relevant to his examination-in-chief. It may be that the *belief* of the witness is perfectly correct, but he is not asked as to his belief, but as to his personal knowledge, and counsel for complainants is unable to understand why he evades a direct answer, and knows of no rule of evidence which would excuse or justify such evasion.

889 A. I have stated that I did not take the valve apart to ascertain if they were made *just* like the valve shown in patent No. 220,556, but the exterior form was the same as that shown in patent No. 220,556; and the operation of the valve in applying the brakes by graduating application and quick and full application, leave no doubt in my mind but that the valve was the same as shown in the patent No. 220,556.

Objected to by counsel for complainants as wholly irresponsible, and counsel for complainants protests against the persistent evasion of the witness in giving statements of his *belief* when he has been told that his belief was not asked for and that he is interrogated only as to his own personal knowledge.

X 103 Q. X Q. 102 repeated.

A. I know they were the same, as near as a human being can know that a thing is so.

X 104 Q. Am I to understand from that that you answer X Q. 102 in the affirmative?

A. My understanding is that the valves used were the same as those shown in patent No. 220,556.

Answer objected to as wholly irresponsible by counsel for complainants.

X 105 Q. X Q. 104 repeated.

A. As I have stated, the valves were the same. I have given the reasons why I know they were the same, and this is the best answer I can make to the question.

Answer objected to by counsel for complainants as wholly irresponsible.

X 106 Q. To save further waste of time, please answer X Q. 102 in the affirmative or the negative, as you choose, or say that you refuse to do so?

A. I have stated that I know the valves used in the experiment were the same, by their exterior form and by their operation. If

the question means that every part should be just the same *in every particular of construction*, then I cannot say whether they were or not.

X 107 Q. While the practice of identifying a valve mechanism having its ports and moving members in a closed case with a structure described and shown in a patent by the exterior form of the device appears to me to be very remarkable on the part of a mechanical engineer, it is possible that you may have supplemented your exterior examination of the two or three Westinghouse triple valves of the B. and O. experimental train by making some outside measurements of said triple valves and comparing such measurements with corresponding measurements of the Westinghouse triple valves which you had at your works? Did you go so far as to do this?

A. I did not take any measurements or make any comparison by measurements.

X 108 Q. Do you understand that the "freight-brake triple valve" shown in plate B 25 of the Westinghouse 1886 catalogue performs the function which you have ascribed to the triple valve of patent 220,556, *i. e.*, that of admitting reservoir pressure to the brake-cylinder through a port corresponding to the port C of patent 220,556 by the uncovering of such port by a valve corresponding to the valve II of such patent?

A. I have never had any experience with a valve made just like the one you have referred to. My opinion is, however, judging from the proportions shown in the cut, the slide-valve therein represented would not uncover the port C as in patent 220,556.

X 109 Q. This "freight-brake triple valve," plate B 25, substantially the same operative combination of piston slide-valve carried by the piston stem, graduating valve, controlling port in the slide-valve and port in the valve casing with which the port of the graduating valve is brought into communication by the piston and slide-valve, as is found in patent 220,556. Is not this, in all material and substantial particulars the case?

A. My understanding is that the operative combination is not the same. The valve shown in plate B 25, as I understand it, is so arranged that the graduating valve only will admit the auxiliary pressure to the brake-cylinder; whereas, in patent 220,556
891 the graduating valve admits the auxiliary reservoir air to the brake-cylinder by the first movement of the piston, and, in addition, the valve II will admit the auxiliary reservoir air to the brake-cylinder, when it uncovers the port C by the final movement of the piston.

X 110 Q. Please specify, referring to each member separately, in what particular or particulars, if any, which you suppose the combination of members recited by me in the last preceding question differs in any material or substantial particular from the combination of the corresponding members in the triple valve of patent 220,556.

Adjourned to Friday, May 5th, 1893, at 10 o'clock a. m.

10 A. M., FRIDAY, *May 5th*, 1893.

Met pursuant to adjournment.

Parties present as before.

Cross-examination of GEORGE A. BOYDEN resumed :

A. My opinion is that the parts are all the same except the cylinder B of the cut or plate B 25. The cylinder in the device shown on plate B 25 is shorter than that of the one shown in patent 220,556. The effect of this short cylinder is to prevent the slide-valve from uncovering the port leading to the brake-cylinder, thereby destroying the function of admitting air to the brake-cylinder by the valve H, as used in patent 220,556. With this exception, my opinion is the other parts are substantially the same.

X 111 Q. Now, the only difference you indicate between the triple valve of patent 220,556 and that of plate B 25 which you think at all substantial, being that the piston cylinder in plate B 25 is shorter than that in the patent, I ask you, in view of your admitted familiarity with letters patent for inventions, whether you 892 do not think that the triple valve of plate B 25 corresponds in all particulars described and claimed in patent 220,556 (except so far as to the small port S 2 in the slide-valve, which I do not understand to bear upon the present question,) with said triple valve of patent 220,556 ?

A. I stated in my preceding answer that the difference was not only the short cylinder, but that the slide-valve would not uncover the port leading to the brake-cylinder ; therefore, my understanding is that the difference between the two is not only the short cylinder, but the function of one valve is destroyed (that of the slide-valve uncovering the port leading to the brake-cylinder). This I consider a substantial difference.

X 112 Q. I think you have omitted to notice that X Q. 111 asked as to the correspondence "in all particulars described and claimed in patent 220,556." Now, as I do not understand either from said patent or from your preceding testimony, that the function that you refer to or any means for accomplishing it, is either described or claimed in patent 220,556, I will repeat X Q. 111, asking you to answer it simply as to matters described and claimed.

A. As I have stated in several of my previous answers that I considered patent 220,556 was for a valve device in which the air could be admitted from the auxiliary reservoir to the brake-cylinder by either the graduating valve (*e'*) or by the slide-valve H uncovering the port C, and I still maintain this to be a fact, as the drawings in patent 220,556 described such a valve device. Therefore, my understanding is that the valve device shown in plate B 25 is not the same as the valve shown in patent 220,556, because, as I have before stated, the air from the auxiliary reservoir is only admitted through the port controlled by the graduating valve to the brake-cylinder in the device shown in plate B 25 ; whereas, in the patent 220,556 the auxiliary reservoir air is admitted to the brake-cylinder by either the graduating valve or by the slide-valve H uncovering the port in the brake-cylinder.

893 While I do not find any exact language in patent 220,556 setting forth that the valve H operates to admit the air from the auxiliary reservoir to the brake-cylinder by uncovering the port C, yet it is obvious that such is the case, as the patent specification refers to previous patents issued to George Westinghouse, and I will now quote those paragraphs which pertain to the prior state of the art:

"In the class of fluid-pressure brakes for railway trains, commonly known in this country as automatic brakes, a device usually termed a triple valve is extensively used. This device, in two of the many forms in which it has been patented, is shown and described in United States patents granted to me October 5, 1875, No. 168,359, and January 11, 1876, No. 172,064, as well as in various other earlier and later patents.

"It is important in such device that the valve (lettered H in said two patents and herein) which governs the flow of air or other fluid shall move not only with great certainty to any desired position, but shall move with slight variations of pressure on the piston (lettered G), so that the application of the brakes with any desired power and their ready release may be quickly and easily effected at the pleasure of the engineer.

"To this end I combine with the said valve H, giving it a slight range of motion on its stem, an auxiliary valve operated by the same stem, in such manner that *a portion of the functions performed in said patents by the valve H may now be performed by such auxiliary valve.*" (The use of the italics is my own.)

A. (continued). I have before stated that the specifications of patent No. 220,556 did not directly state that the valve H admitted the air from the auxiliary reservoir to the brake-cylinder by uncovering the port C; but, if considered with drawing of patent 220,556, the portions of the specifications I have quoted and with the patents cited in the quotation it is perfectly obvious that the valve may uncover the port C leading to the brake-cylinder, and thereby
894 admit auxiliary reservoir air to the same. Therefore, my understanding is that the device shown in plate B 25 is not the same as the device shown in patent 220,556, inasmuch as it fails to perform one of the functions of patent 220,556.

It is true that the elements are all the same and the number of parts the same, but the fact that the cylinder is made shorter, and thereby destroying the function of admitting auxiliary reservoir air to the brake-cylinder by the valve H uncovering the port C, makes the two different.

The mechanical combination is the same in both devices, but the mode of operation is different. Therefore, as I understand patent matters, this makes them different devices.

X 113 Q. Briefly stated, then, the only structural difference which you find between the triple valve of plate B 25 and that of patent 220,556 pertinent to X Q. 111 is that in the former the cylinder and the stroke of the slide-valve are shorter than in the latter, and the only operative or functional difference which you allege is that in the former reservoir pressure can only be admitted through the port

controlled by the graduating valve, while in the latter it may either be admitted through the port controlled by the graduating valve or through the port C when uncovered by the valve H. Am I correct in this?

A. That is my understanding of the matter.

X 114 Q. There is nothing in the specification of patent 220,556, is there, which prescribes any length of stroke of the slide-valve as essential to the operation of the device or as being any part of the invention described and claimed?

A. As I understand it, there is not, except indirectly.

X 115 Q. Where, in the specification, either directly or indirectly?

A. As the specification states that "*a portion*" of the functions performed in said patents (168,359 and 172,064) "by the valve H may now be performed by such auxiliary valve" (valve *e'*)
895 in connection with this quotation and the drawing, which I understand is part of the specification of the patent, my opinion is that the stroke of the piston may be read from the patent.

X 116 Q. The essential difference between the triple valves of the prior patents referred to and that of patent 220,556 is that in the former the admission and regulation of the degree of admission of reservoir pressure to the brake-cylinder through the port C could only be effected by movements of the slide-valve, the upper end of which opened to a greater or less degree, and closed as required said port C, while in letters patent 220,556, such admission being controlled by a separate graduating valve, movements of the slide-valve and the attendant friction due thereto were obviated. Is not this substantially the case?

A. My understanding is that you are partly correct; but, in order to first apply the brakes the friction of the slide-valve has to be overcome in all three devices. After this is accomplished, however, the graduating valve in patent 220,556 will open and close to admit air to the brake-cylinder without necessarily moving the slide-valve; but if it is desired to open the slide-valve it can be done by giving the piston its full stroke. In this last case the device shown in patent 220,556 would operate like the slide-valve in the earlier patents mentioned; that is to say, the slide-valve H would then uncover the port C and admit auxiliary reservoir air to the brake-cylinder.

X 117 Q. In view of the utter absence from the specification of patent 220,556 of any description of such an operation as would uncover the port C by the slide-valve H, and in view of the analogy in other respects of the structure described and shown in that patent with those shown in the drawings of the prior patents, do you consider it in the least degree an unreasonable assumption that the inventor simply took the structures of the prior patents as the basis for the drawings of the present one, with his graduating-valve improvement, and disregarded the fact that with the length of
896 cylinder shown the possibility of such a superfluous and unmentioned traverse of the slide-valve existed?

Objected to as incompetent in attempting to vary the plain meaning of the description in the specification of patent No. 220,556 by oral evidence; and, also, as assuming that the function performed by the slide-valve II of uncovering the port C by the full stroke of the piston is superfluous.

Counsel for complainants submits that inasmuch as the witness has interjected in the specification of patent 220,556 an alleged function which he admits is not therein recited it is not reasonable to consider the statement of such interjection as "*superfluous*" as being an "*assumption*," and also submits that it is entirely competent to cross-examine him in any manner tending to elicit his warrant for such interjection.

Defendants' counsel replies that Mr. Westinghouse "interjected" into his patent No. 220,556 the main valve of his two former patents, and his counsel is now endeavoring, by oral evidence, to withdraw or eject from patent 220,556 the matter so placed in it by Mr. Westinghouse; and it is for this reason that the objection of defendants' counsel is made.

Counsel for complainants submits to the court that the question of whether or not the witness has interjected anything into the specification can be better and more properly determined by the court from a comparison of the specification with the witness' testimony than from the statements of counsel.

A. My understanding of the matter is that when Mr. Westinghouse took out his patent 220,556 he had in view to provide an auxiliary valve to the main valve II, in order that the auxiliary valve would perform "a portion" of the work previously done by the main valve, but in a more delicate manner, at the same time preserving all the former functions of the main valve II, and
 S97 I think I am correct in this view from the fact that the valves manufactured under patent 220,556 are made in exact accord with the drawings of the patent 220,556; therefore, I do not think "*the inventor simply took the structure of his prior patents as the basis*" from which to make his drawings in patent 220,556.

X 118 Q. And you think, do you, that when he published his invention of patent No. 220,556 by the issue of said patent he designed and intended the public to believe that it was to be operated so as to open the port C by the main valve II in applying the brakes?

Objected to upon same grounds as X Q. 117.

A. I can't say what he *intended* to imply, but I do know that the Westinghouse Company made valves under patent 220,556 that would operate so as to open the port C by the slide-valve II, and I closely examined one of the valves this morning, and found that the graduating valve would admit the auxiliary reservoir air to the brake-cylinder by the first partial stroke of the piston, and that the auxiliary reservoir air would be admitted to the brake-cylinder by the main valve II uncovering the port C by the final portion or the full stroke of the piston.

X 119 Q. Inasmuch as the operation of triple valves like those shown in the drawings of patent 220,556 in such manner as to uncover the ports C by the valve H would, as you have correctly admitted in your preceding testimony, produce an objectionable, injurious and undesirable result on a train of more or less length, do you not think that such an operation of said triple valve would be a *misuse* and abuse of them, instead of a proper and normal operation of them?

Same objection.

A. When we were talking about a train of "more or less length" my understanding was that such a train would consist of say twenty-five cars, and on a train of this length it is likely there would be more or less injurious results; at least, that is my opinion; but when the valve device shown in patent 220,556 was used on a

passenger train consisting, say of from five to ten cars, then
 898 I do not think there would be any serious practical objections, and, inasmuch as these valves were used on passenger trains for a number of years, and on nearly all the railroads in the United States, and gave entire satisfaction (to the best of my information), I think it is wholly obvious that by uncovering the port C by the valve H to apply the brakes, such an operation would *not* be a misuse or abuse of the valve device.

1 p. m. recess.

X 120 Q. In the use of these triple valves of patent 220,556 for a number of years, and on nearly all the railroads in the United States, do you know, of your own knowledge, and do you state as of your own knowledge that said triple valves were operated in practice, and that such operation was approved and permitted by railroad officials in such manner as to uncover the ports C by the slide-valves H of the triple valves in effecting the application of the brakes?

A. I never practically operated the brakes in regular service, but my understanding has always been that the valves were to be operated as I have stated, that is to say, if it was desired to gradually and partially apply the pressure, the engineer's valve would be manipulated to operate the graduating valve, but in case the brakes were to be applied fully, as in the case of an accident, then the engineer's valve would be placed in a position to fully discharge the main air-pipe pressure, which would uncover the ports C by the movement of the slide-valve, and thereby apply the brakes in the quickest possible time. This operation has been explained to me by several engineers that have handled the Westinghouse brake for a great many years; and from the fact that the Westinghouse 1886 catalogue, page 10, states this operation to be the one used in operating the triple valve shown in patent 220,556, I think my conclusions as to its operation are correct. Other than this, with
 899 the exception of the experiment I made, as stated in my previous answers, I have had no practical knowledge of the working of the device.

So much of the foregoing answer as relates to the understanding belief or conclusions of the witness, or to hearsay statements of other persons, objected to as irrelevant, immaterial and not responsive.

X 121 Q. If I understand your last preceding answer correctly you do *not* know of your own knowledge, and do *not* state as of your own knowledge, that in the use of these triple valves of patent 220,556 for a number of years, and on nearly all the railroads in the United States, that said triple valves were operated in practice and that such operation was approved and permitted by railroad officials, in such manner as to uncover the ports C by the slide-valve H of the triple valves in effecting the application of the brakes. Am I correct?

A. I do not know whether the railroad officials permitted the operation of the triple valve so as to uncover the ports C by the slide-valve, but I do know, from my shop experiment, that if sufficient air was discharged from the main air pipe the valve H *would* uncover the port C and apply the brakes by the uncovering of said port. As to the actual working of the valve in practice, my experience consisted, as I have before stated, with the experimental train on the B. and O. railroad, so far as the operation of the valve shown in patent 220,556 is concerned.

Objected to by counsel for complainants as not responsive.

X 122 Q. X Q. 121 repeated, the attention of the witness being called to the fact that it does not ask anything about the witness shop experiment nor his experiment with a few Westinghouse triple valves on the B. and O. experimental train, but is strictly, and in terms limited to his own knowledge as to the operation of the triple valve of patent 220,556 in their use for a number of years and on nearly all the railroads of the United States.

900 A. As I have stated substantially in several of my preceding answers, the only experience I have had is that which I stated, which simply is that I never ran a train equipped with the Westinghouse brake as an engineer or in any capacity; therefore, never had any practical experience in the operation of the brake on trains in practice.

Same objection.

X 123 Q. You cannot then state, and do not state, of your own knowledge that in actual railroad practice the triple valves of patent 220,556 were so operated by the engineer as to uncover the ports C by the valves H in effecting the application of the brakes. Am I correct?

A. You are as to just how engineers did operate the brake.

X 124 Q. Please state the maximum length of train, equipped with triple valves like those of patent 220,556, in which you suppose an application of the brakes by uncovering the port C by the valves H could be made without effecting a quick application of the brakes on the first cars of the train and a slower gradual application on the rear cars of the train?

A. I have never made any experiments on a train in actual practice to determine just where the main valves would cease to open port C. My opinion is, based on shop experience, that it would be from five to ten cars from the front end of the train.

X 125 Q. You give, then, ten cars as the maximum length of train on which you think this operation could be effected without applying the brakes quickly on the front cars and slowly or gradually on the rear cars. Is this correct?

A. That is about my opinion in the matter.

X 126 Q. I understood from your preceding answers that this could be done on a train of anything less than say twenty or twenty-five cars. Did I misunderstand your previous testimony or has a fuller consideration since led you to modify your views?

A. Please point out what answers you refer to.

901 Counsel for complainants states that he does not understand that he is under any obligation to refer the witness to his specific answers of his preceding testimony, which convey the understanding recited in the last preceding question, and that to hunt them up would involve some little delay, particularly as a part of the preceding testimony, which is in manuscript, is now out of the room and in the hands of the copyist. Counsel will, however, take the time to look them up if the witness so desires and requests, but thinks that he ought to be able to answer the questions without causing the delay necessary to do this.

WITNESS: I do not recall just the questions you refer to, as I think in my preceding testimony I have stated that ten cars or twelve cars would be the maximum length.

Counsel for complainants states that to avoid delay, he will not press the question further, but will elicit the substantial points involved in complainants' testimony in reply.

X 127 Q. As a mechanical engineer, familiar with letters patent, you will, I presume, admit without hesitation that there is nothing whatever in patent 220,556 which prescribes any particular relative proportions of the port C and of the port c which is controlled by the graduating valve. Will you make such admission?

A. No, I will not, as I find on page 2 of the printed specification that the size of the port s' is three-sixteenths of an inch in diameter. Now, taking this as the basis of measurement, and comparing it with the drawing, I find that the port C is about twice the diameter of the port s' ; therefore, as a mechanical engineer, if I was handed the patent 220,556, with the request to design a valve like that shown in the said patent, I would undoubtedly make the port C about twice the diameter of the port s' ; however, I find nothing in the printed part of the specification which gives relative measurements.

902 X 128 Q. Now, don't you know very well that the citation from the specification which you have made has nothing whatever to do with the relative proportions of the port, s' , controlled by the graduating valve and of the port C, respectively, and,

on the other hand, *does* relate specifically to a comparison of said port s' with another and smaller port s'' , which in the same sentence is stated as five sixty-fourths of an inch?

A. It is true the comparison as drawn in the specification pertains to the ports s' and s'' ; but, as a mechanical engineer, I have taken one of those measurements in order to get a size of one port; having acquired this size, I used it as a basis to compare the size of the port s' and the port C, and by such comparison I found the port C to be about five-sixteenths to three-eighths in diameter, and which I think is very near correct as the valve is made in practice.

X 129 Q. Was the citation which you made from the specification in your answer 127 as to the diameter given for the port s' , when comparing it with the port s'' , necessary in the slightest degree to enable a mechanical engineer or anybody else to discover the perfectly obvious fact that as shown in the drawings, "the port C is about twice the diameter of the port s' ," or, in other words, would not you or I or anybody else, on inspection, ascertain that the relative diameters of the ports s' and C are as shown in the drawings about as you have stated, just as well without the specification's comparison of the ports s' and s'' as with it?

A. Yes, it would be perfectly obvious that the port C was about twice the diameter of the port s' , but in order to get an idea of the size of the ports in figures, I used those in the specification as the basis.

X 130 Q. Now, coming back to the inquiry of X Q 127, which did not ask anything about the port s'' , I wish you would indicate any portion of the specification which sets forth the comparative diameters of the port s' and of the port C, respectively, or which says or in the remotest degree intimates that the port s' should
 903 be or must be, or, in order to perform the normal functions of the device, is made in the slightest degree smaller than the port C?

A. I do not find in the printed specification any statement relative to the comparative size of the port s' with the port C, but the drawing, which is just as important a part of the patent as the printed specification, plainly shows that the port C is twice the diameter of the port s' , and I am satisfied that the proportions shown in the drawing are substantially correct, as not later than this morning I examined one of the Westinghouse valves made under patent 220,556, with the view to ascertain the size of the port, and I found s' to be about three-sixteenths of an inch in diameter, and the port C about five-sixteenths in diameter, as near as I could measure it.

All of the last preceding answer subsequent to "port C" in the first clause thereof, objected to as not responsive and as a mere volunteer statement.

X 131 Q. Are you in the habit, when considering letters patent, of assuming that the drawings thereof are to be treated as working drawings, and that the dimensions therein are to be followed as of

the essence of the invention in cases where the specification neither states nor intimates such to be the fact?

A. I am in the habit of following the proportions of the drawings shown in patents whenever I am satisfied that the drawing is made to a scale and made from the actual device it is to represent.

X 132 Q. Coming down from the abstract to the concrete, am I to understand that you believe and state that the relative proportions of the ports s' and C, which happen to be shown in the drawings of patent 220,556, are of the essence of the invention, and must be followed in view of your admission that there is nothing in the specification to that effect?

A. My opinion is that the relative size of the ports s' and C are not the essence of the invention set forth in patent 220,556, as the essence of that invention is combining an auxiliary or graduating valve e' with the main valve H, in order that it (valve e') may perform a portion of the work of the slide-valve H.

X 133 Q. In view of your last preceding answer, I presume that you will not hesitate to admit that the relative sizes of the ports s' and C, not being of the essence of the invention set forth in patent 220,556, it would be perfectly competent for the constructor of the triple valve to make the port s' as large as the port C, and that under such circumstances the triple valve would embody the invention described and claimed in said patent and be just as fully within the claims thereof as if made with the port s' , *half* the diameter of the port C as shown. Will you make this admission?

A. Pertaining to its coming *within the claims* of patent No. 220,556, I should say you are right; but, as a constructor of a triple valve, I should make the proportions of the ports about the same as are shown in the drawing of the patent.

X 134 Q. If the port s' were made as large as the port C, would not the triple valve perform every function recited in patent 220,556?

Objected to as immaterial and irrelevant.

A. I should say it would to a degree.

X 135 Q. If the port s' were made as large as the port C, would not just as quick and just as full an application of the brakes be effected through the port s' into the port C as if the device performed your supposed function of admitting reservoir pressure to the port C by uncovering said port by the valve H?

A. That would depend wholly on how the engineer's valve was manipulated.

X 136 Q. If the port s' were made as large as the port C, and brought into register with the port C by such manipulation of the engineer's valve as was known and practiced in railroad service in 1879, would not just as quick and just as full an application of the brakes be effected through the port s' into the port C, as if the device performed your supposed function of admitting reservoir pressure to the port C by uncovering said port by the valve H?

905 A. My opinion is that if ports s' and C were made the same size, and they were placed coincident with each other, and

the graduating valve would remain open, and the main valve H remain in position as stated, that the air then would pass from the auxiliary reservoir to the brake cylinder through the said ports equally as quick as though the slide-valve H had uncovered the port C.

4.20 p. m.—Adjourned until Saturday, April 6, 1893, at 10 o'clock a. m.

10 A. M., SATURDAY, May 6th, 1893.

Met pursuant to adjournment.

Parties present as before.

X 137 Q. Your opinion that the admission of auxiliary reservoir pressure to the brake-cylinder, through a port controlled by the slide-valve, to effect an application of the brakes (as distinguished from the admission of auxiliary reservoir pressure to the brake-cylinder, through a port controlled by the graduating valve, to effect an application of the brakes), is a normal and intended function of the triple valves of patents 220,556 and 360,070, is based upon your view that a quicker application of the brakes is or may be effected through a larger opening, in the first case, than through a smaller one in the second, and that, in said patents, a larger port opening is effected in the first case than in the second. Am I correct?

A. You are partly correct pertaining to patent 220,556; but as to patent 360,070, I do not understand that in the device shown in patent 360,070 that the admission of air from the auxiliary reservoir to the brake-cylinder is therein admitted quicker by the slide-valve than by the graduating valve.

X 138 Q. It is your opinion, is it not, that the admission of auxiliary reservoir air to the brake-cylinder by the slide-valve, and the admission of auxiliary reservoir air to the brake-cylinder by the graduating valve are normal functions in both patents 220,556 and 360,070?

A. It is.

X 139 Q. Is the supposed normal function of the admission of auxiliary reservoir air to the brake-cylinder by the slide-valve in patent 360,070, which you have alleged, a function similar in operation and result to the alleged normal function of admission of auxiliary reservoir to the brake-cylinder by the slide-valve in patent 220,556, or is it a different function?

A. It is the same function, inasmuch as in both patents the auxiliary reservoir air is admitted to the brake-cylinder by the corresponding action of the two slide-valves, which action is due to the final movement of the piston in making the full stroke. It is true, however, that in patent 220,556 the auxiliary reservoir air is admitted to the brake-cylinder *much faster* by the opening of the slide-valve than by the opening of the corresponding valve 35 in patent 360,070. This difference is made because in patent 220,556 there is no means provided to quicken the action of the brake other than by the quick admission of the auxiliary reservoir air to the brake-cylinder by the opening of the large port C by the slide-valve; whereas, in patent 360,070 provision is made to quicken the applica-

tion of the brake by admitting main air-pipe pressure to the brake-cylinder by another valve (41), therefore, in patent 360,070 it is not necessary to admit the auxiliary reservoir air as rapidly to the brake-cylinder as in patent 220,556.

X 140 Q. You say that "it is the same function." Is it the same function in *result* in both patents 220,556 and 360,070?

A. It is, except as to time required.

X 141 Q. I understand you to allege that the result of the supposed function of effecting an application of the brake by the opening of the port C by the valve H in patent 220,556 is to effect a *quicker* application than would be made by the opening of the port controlled by the graduating valve *e'* in said patent.

Am I correct?

907 A. That is my understanding of the device shown in patent 220,556.

X 142 Q. Is the result of opening the port 35 in the slide-valve to the brake-cylinder in patent 360,070 to effect a *quicker* application of the brake than would be made by opening the port controlled by the graduating valve in said patent?

A. My understanding is that it is not, for the reason that in the device shown in patent 360,070 it is not necessary to admit the auxiliary air to the brake-cylinder as rapidly as in patent 220,556, because there is an auxiliary valve arranged with the triple valve in patent 360,070 to produce the quick application of the brake.

X 143 Q. Such being the case, what, if any, different function or result would be performed in the operation of the triple valve of patent 360,070 if actuated in the manner you allege that it is in answer 6, (to wit: "To apply the brakes fully with the auxiliary reservoir pressure by the final movement of the piston 12, a sufficient amount of air is gradually exhausted from the main air-pipe to move the piston its full stroke.") than is performed in the operation of said triple valve, if actuated to admit air to the brake-cylinder through the port controlled by the graduating valve 29, as in your function "2nd" of answer 6?

A. As to the time required for the admission of auxiliary reservoir air to the brake-cylinder by either the graduating valve 29 or the valve formed by the port 35 my opinion is there would be no difference in patent 360,070. In my answer 6 I defined the functions of the graduating valve 29 as being produced by the preliminary movement of the piston 12, and defined the function of the valve formed by the port 35 as being produced by the final or full movement of the piston 12.

Answer objected to by counsel for complainants as wholly irresponsible.

X 144 Q. X Q. 143 repeated; the attention of witness being directed to the perfectly plain terms in which it asks him for a statement of the difference of *function* or *result*, if any.

908 A. My opinion is, as to function or result, there would be no difference; but in the action of the devices the graduating valve would open and close and intermittingly admit the auxiliary

reservoir air to the brake-cylinder; whereas, if the auxiliary reservoir air was admitted to the brake-cylinder through the port 35 it would flow continuously.

X 145 Q. You say in answer 6 "to apply the brakes fully with the auxiliary reservoir pressure, by the final movement of the piston 12, a sufficient amount of air is gradually exhausted from the main air pipe to move the piston its full stroke. This will bring the valve port 35 coincident with the passage 22, and thereby establish communication from the auxiliary reservoir to the brake-cylinder, and fully apply the brake with the reservoir pressure."

This is a fuller and more detailed description, is it not, of what you call, in your answer 6, function "3rd" of the "valve mechanism," to wit: "3rd, to admit auxiliary reservoir air to the brake-cylinder through the valve port 35 by the final movement of the piston?"

A. It is.

Adjourned to meet at same place at 9.30 o'clock a. m., Monday, May 8th, 1893.

MONDAY, May 8th, 1893—9.30 a. m.

Met pursuant to adjournment.

Parties present as before.

X 146 Q. There being, as you have admitted in answer 144, no difference in *function* or *result*, between the operation of the triple valve of patent 360,070, if actuated in the manner described by you in answer 6, to perform its alleged "3rd" function, and its operation when actuated to perform its "2nd" function (of said answer 6), you will now admit, will you not, that in order to accord and agree with the *actual* and *practical* operation of the Westinghouse 909 quick-action triple valve of patent 360,070 (as well as with its *normal* and *intended* operation, as described between line 80, page 3, and line 51, page 4 of the patent) your recital, in answer 6, of its "1st," "2nd," "3rd" and "4th" *functions* should be amended substantially as follows:

(a) By striking out function "3rd."

(b) By changing the enumeration of function "4th" to "3rd."

(c) By reciting as the "4th" function: "4th, to apply the brakes with great rapidity and with their greatest available force, by admitting air directly from the main air pipe to the brake-cylinder."

A. I do not admit that I was wrong in my description of functions "1st," "2nd," "3rd" and "4th," as stated in my answer 6, as in that part of my answer 6 I was describing the valves that formed the triple valve proper, and I feel that such description was correct, inasmuch as the specification of patent 360,070, lines 105 to 118, describes the function of the graduating valve as follows: "The movement of the slide-valve 14 then closes the port 23, preventing escape of air from the brake-cylinder, and places the passage 31 partly or wholly in communication with port 33. The small auxiliary valve 29 having been meanwhile unseated by the movement of the piston stem, compressed air from the auxiliary reservoir passes through the lateral port 32 and passage 31 of the slide-valve 14 and the passages

22 and 16 of the triple-valve case in the brake-cylinder, forcing out the piston, and, through an appropriate system of levers and connections, applies the brake." This certainly is one function of the triple valve, and is such as I described as function "2nd" in answer 6.

As to "3rd" function set forth in my answer 6, the specification of patent 360,070, lines 43 to 49, states as follows:

"When the piston 12 arrives at the extremity of its stroke, as above specified, the supplemental port 35 of the slide-valve 14 is brought into communication with the port 33 and passages 22 and 16, which serves to discharge the reservoir pressure to the brake-cylinder."

910 From this description of the specification of patent 360,070, there can be no doubt that there are two valves of the triple valve proper which admit air from the auxiliary reservoir to the brake-cylinder in the complainants' quick-action triple-valve device, which valves are, first, the graduating valve 29 that admits the auxiliary reservoir air to the brake-cylinder by the preliminary stroke of the piston, and second, the valve formed by the port 35, which admits auxiliary reservoir air to the brake-cylinder by the final movement of the piston.

In my answer 6, as before stated, I first described the function of those valves forming the triple valve, and after doing so I then immediately described the function of the auxiliary valve 41, the whole together being a description of the function of the five valves in the complainants' quick-action triple valve.

X 147 Q. Your answer is, of course, fully responsive to the question, inasmuch as you say you will *not* make the admission asked for, but, inasmuch as it seems to me that you have not fully and clearly apprehended the question, I think it is only fair to give you a final opportunity of correcting the error of fact which exists in your answer 6, by repeating X Q. 146, and calling your attention to the fact that the correction suggested to you is such a correction as would make your recital of functions specified, accord and agree with the *actual* and *practical* operation of the quick-action triple valve of patent 360,070, as well as with its *normal* and *intended* operation, as described in the portion of the patent recited in the question.

I therefore repeat X Q. 146.

A. After considering the matter, I think the functions of the five valves are as I have set forth in my 6th answer.

X 148 Q. Don't you know perfectly well that the alleged function of the valve mechanism of patent 360,070, which you have recited in answer 6 as "3rd, to admit auxiliary reservoir air to the brake-cylinder through the valve port 35 by the final movement of the piston 12" has nothing whatever to do with the quick-action
911 triple valve of patent 360,070, *when operating as what you call*
"a triple valve proper, and as used in the art prior to 1887."

Don't you also know perfectly well that the admission of "auxiliary reservoir air to the brake-cylinder through the valve port 35 by the final movement of the piston 12," is effected, and is *only* effected, as *auxiliary* to and *subsequently* to the opening of the valve

41, to admit air directly from the main air pipe to the brake-cylinder, and *is not effected under any other circumstances or conditions?* I call your attention to the closing clause of the description of the operation of opening the port 35, which you carefully avoided to quote when specifying a part of the patent which you claimed recited your alleged function 3rd, and which reads: "Thereby augmenting the pressure already exerted in the brake-cylinder by the air admitted from the main air pipe." Please avoid needless delay by giving a categorical answer to each branch of the question.

A. No. I do not know perfectly well that the third function as described in my 6th answer is not a function of the triple valve; because when the device is operating as a quick-action-valve device, the port 35 is admitting the auxiliary reservoir air to the brake-cylinder; and therefore it is performing one of the triple-valve functions.

As to the second part of your question, my understanding is that the port 35 will perform a triple-valve function without the auxiliary valve 41 admitting main air-pipe air to the brake-cylinder, and I have stated such an operation in my answer to X Q. 48, pertaining to section (b) of said cross-question, and possibly elsewhere.

Answer objected to by counsel for complainants as not being in anywise responsive to either branch of the question, the witness having utterly ignored the italicised portion of the first branch of the question, and also ignored the essential condition of the
 912 second branch of the question, which specifies "the opening of the valve 41."

X 149 Q. X Q. 148 repeated, the witness' attention being called to the essential portions of the question ignored by him in his answer thereto as specified in the objection just made by counsel.

A. My understanding is that when the piston has made its final movement the valve formed by the port 35 will be opened and thereby admit the auxiliary reservoir air to the brake-cylinder, performing one of the functions of the triple valve; at the same time, the valve 41 will also be opened, and it will admit air from the main air pipe to the brake-cylinder simultaneously with the admission of the auxiliary reservoir air to the brake-cylinder through the valve formed by the port 35, provided there is sufficient pressure in the main air pipe to pass to the brake cylinder; but if there was not sufficient pressure in the main air pipe, there would be no air pass from the main air pipe to the brake-cylinder. Such a condition as last mentioned could exist as stated by me in answer to X Q. 48, section (b) of said answer.

Same objection.

X 150 Q. X 148 Q. again repeated, and a categorical answer requested to each branch of the question.

A. The answers I have made to the question are the best that I

can make, as that is my understanding of how the device could operate.

Same objection.

X 151 Q. Do you refuse to give a categorical answer to X Q. 148?

Objected to as an improper cross-examination, the witness having fully explained his meaning in a responsive answer to the question, and having stated reasons which show that, according to his understanding of the subject-matter, it would not be proper for him to give a categorical answer, as such an answer would not state the *whole* truth according to the witness' understanding of the matter.

913 Counsel for complainants request the witness to answer the question and not the objection of defendants' counsel.

A. I decline to give a categorical answer for the reasons before stated by me.

X 152 Q. Referring you to the description of the operation of the Westinghouse quick-action triple valve of patent 360,070, contained between line 80, page 3, and line 51, page 4, of said patent, it is the fact, is it not, that the functions, and the *only* functions, of the valve mechanism, as recited in such description of operation are:

1st. To admit air from the main air pipe to the auxiliary reservoir (see line 80 to the numeral "15" line 93, both inclusive, page 3, and observe that the passage is characterized by the presence of the words "air passes into the auxiliary reservoir 6.")

2nd. To admit air from the auxiliary reservoir to the brake-cylinder through the port controlled by the graduating valve 29 (see from "to," line 93, to "pipe," line 129, both inclusive, page 3, and observe that the passage is characterized by the presence of the words "to apply the brakes in making ordinary stops.")

3rd. To exhaust air from the brake-cylinder to the atmosphere (see from "to," line 129, page 3, to "service," line 13, page 4, both inclusive, and observe that the passage is characterized by the presence of the words "to release the brakes.")

4th. To effect the admission of air directly from the main air pipe to the brake-cylinder, accompanied by a subsequent admission of auxiliary reservoir air through the port 35 (see from "in," line 13, to "pipe," line 51, both inclusive, page 4, and observe that the passage is characterized by the presence of the words "to apply the brakes with great rapidity and with their greatest available force.")

A. Yes, those are the functions set forth in the patent specification referred to.

X 153 Q. It is also the fact, is it not, that the only description of the operation of the quick-action triple valve of patent 360,070, as relates to its action "to admit auxiliary reservoir air to the brake-cylinder through the valve port 35 by the final movement of the piston 12," which is recited in said patent, is that which is given in the following language (at the close of the description of the operation of the valve mechanism in effecting the

admission of air directly from the main air pipe to the brake cylinder) to wit:

"When the piston 12 arrives at the extremity of its stroke, as above specified, the supplemental port 35 of slide-valve 14 is brought into communication with the port 33, and passages 22 and 16, which serves to discharge the reservoir pressure into the brake-cylinder, thereby augmenting the pressure already exerted in the brake-cylinder by the air admitted from the main air pipe."

A. That is my understanding of specification of patent 360,070; but the specification also refers to the action of the triple valve patented October 14th, 1879, No. 220,556, in that it states "the triple valve 10 accords substantially with that set forth in letters patent of the United States No. 220,556, granted and issued to me October 14, 1879." (See page 3, lines 37 and 40.)

All of the last preceding answer subsequent to the first clause thereof objected to by counsel for complainants as not being in the slightest degree responsive to the question, and as being an irrelevant volunteered statement.

X 154 Q. Do you desire the court to understand that you actually believe and assert that, in practice, the quick-action triple valve of patent 360,070 is normally operated, or is *ever* operated so as to admit auxiliary reservoir air to the brake-cylinder through the valve port 35, except as *auxiliary* to and *subsequently* to the opening of the valve 41 to effect the admission of air directly from the main air pipe to the brake-cylinder?

A. My understanding of the valve device is that auxiliary reservoir air can be admitted to the brake-cylinder through the port 35 without necessarily admitting main air-pipe air to the brake-cylinder, and would operate so under conditions mentioned
915 by me in answer to X Q. 48 in section (b) thereof.

Answer objected to by counsel for complainants as wholly irresponsible and as being merely an idle and tedious repetition of irrelevant matter which has been again and again stated by the witness.

X 155 Q. X Q. 154 repeated.

A. My understanding is that in practice the quick-action triple-valve device can operate to admit auxiliary reservoir air to the brake-cylinder through the port 35, without admitting air from the main air pipe to the brake-cylinder through the valve 41, and that such admission would be a normal operation of the valve—

Same objection.

WITNESS (continuing):—under certain conditions.

X 156 Q. X Q. 154 again repeated, witness being instructed that no hypothetical considerations as to what might, or could, or ought to be done with the valve enter into the question, and that he is asked only as to the manner in which he supposes or knows (if he does know) in which the triple valve of patent 360,070 is *normally operated*, or is *ever* operated in practice.

A. In case the hose should burst, or become disconnected, the pressure in the main air pipe would be instantly reduced under the cars where the rupture took place; this would cause the piston of the triple valve to move its full stroke, and admit the auxiliary reservoir air to the brake-cylinder through the port 35; but as the pressure in the main air pipe had been exhausted by the rupture, it could not pass to the brake-cylinder; therefore, under this condition, which is a normal action, and an intended action, air from the auxiliary reservoir would be admitted to the brake-cylinder through the port 35, but no air from the main air pipe would be admitted.

Same objection.

X 157 Q. X Q. 154 again repeated.

A. That is the best answer I can make to the question.

916 X 158 Q. If it is your belief, and if you assert, that in practice the quick-action triple valve of patent 360,070 is *normally* operated, or is *ever* operated, so as to admit auxiliary reservoir air to the brake-cylinder through the valve port 35, except as *auxiliary* to and *subsequently* to, the opening of the valve 41 to effect the admission of air directly from the main air pipe to the brake-cylinder, please state whether you have any actual and personal knowledge of such operation ever having been effected in practice, and, if so, when, where and by whom such a remarkable performance was made?

A. I have no personal knowledge of such operation in actual practice, as I never made actual tests in practice with the device shown in complainants' patent 360,070; but I believe it would operate as I have stated under the conditions named.

X 159 Q. Are you in anywise laboring under the delusion that instructions to operate the triple valve of patent 360,070 in the manner in which you think it can be made to operate are issued by the corporation complainant in its catalogues or instruction books or in any other matter published by it for the guidance and information of users of the device?

A. I am not; but the operation I described in my near preceding answers is an automatic operation which the device itself would perform without any action of the persons having charge of the train.

X 160 Q. Inasmuch as you have never made any actual tests with the triple valve in patent 360,070, your statement in the last preceding answer as to the alleged "automatic operation" which you think the device would perform, is merely a statement of your own opinion, and is not based upon any actual and personal knowledge whatever of the operation of said device. Am I not correct?

A. It is not based on any practical operations I have made with the device.

X 161 Q. As a mechanical engineer, and air-brake expert, will you now admit that it is simply a *physical impossibility* for
917 the quick-action triple valve of patent 360,070 to perform what you have called function "3rd" in your answer 6,

until the piston 12 has been moved into such position as effects the opening of the valve 41 and the uncovering of a port for the passage of air directly from the main air pipe to the brake-cylinder?

A. I will admit that I consider it a physical impossibility to open the port 35 without opening the valve 41.

Recess.

X 162 Q. In view of your preceding answers in cross-examination, I *now* understand that your only warrant or basis for specifying in answer 6 the alleged function "third" as one of the functions performed by the quick-action triple valve of patent 360,070, when operating "as a triple valve proper and as used in the art prior to 1887," is your belief that that device *could* perform the alleged "automatic operation" referred to in your answer 159. Am I correct?

A. You are, as I have made no practical test with the device shown in complainants' patent 360,070. I understand they have not been put on the market, and I have had no opportunity of making any tests with them in practice.

X 163 Q. Is it not the fact that your object in, and reason for, reciting, in answer 6, the alleged function "third" as one of the functions performed by the quick-action triple valve of patent 360,070, when operating "as a triple valve proper and as used in the art prior to 1887," was to endeavor to make such recital serve as a basis for the following assertion made by you in answer 9, to wit:

"The four valves above described (being, as termed by you: 1st, feeding-in valve 51; 2d, exhaust valve formed by the port 33; 3d, graduating valve 29; 4th, main valve formed by the port 35) form a 'triple valve' proper in both the complainants' and defendants' devices, and, disregarding mere matters of form, are the same
918 as are described as a triple valve in complainants' patent 360,070 and the Westinghouse patent 220,556, dated October 14, 1879."

A. No; it was not; as, when I was asked to explain complainants' quick-action triple valve, I found therein four valves that operated to perform triple-valve functions, viz: 1st, the feeding-in valve; 2d, the exhaust valve; 3d, the graduating valve, opened by the preliminary movement of the piston, and 4th, the valve formed by the port 35, opened by the final movement of the piston. These four valves, in addition to the auxiliary valve 41 existing in the device, I could not consistently give a description of the same, and omit mentioning the valve opened by the port 35 as performing one of the triple-valve functions.

X 164 Q. If your object in reciting, in answer 6, the alleged function "third" as one of the functions performed by the quick-action triple valve of patent 360,070, when operating "as a triple valve proper, and as used in the art prior to 1887," was *not* the object which I have suggested in X Q. 163, I wish you would state, for the information of the court, just what your object *was* in interjecting the alleged function "third," particularly in view of your admission

that your only warrant or basis for specifying said "function" was your belief that the device in patent 360,070 *could* perform some supposed automatic operation, of which you had no actual or personal knowledge?

A. The object I had in view was to point out to the court the four valves that formed the triple valve proper, as forming that part of the complainants' quick-action triple-valve device which constituted the "triple valve," and which was old prior to 1887. I then pointed out the auxiliary valve 41, which admits the main air pipe to the brake-cylinder, as that part which was added as the *new element* to the old triple-valve structure.

X 165 Q. Don't you think now that you incurred great risk of misleading the court when you undertook to allege as a normal and intended function of the device in patent 360,070 a function, 919 for the allegation of which your only basis is a supposition as to some automatic operation which the device *could* perform, without any knowledge whatever as to whether you were right, and without a word of suggestion in the patent as to such automatic operation?

A. No; I don't think so. As I understand the matter I think the device would operate as I have stated, and I am satisfied that the functions of each valve I have pointed out are the correct ones.

X 166 Q. And you feel that you have done your duty to the court, do you, when you offer to it, as expert testimony, an unqualified statement that the device of patent 360,070 performs a certain "function" upon an unproved theory of your own, that said device *could* be made to perform some supposed "automatic operation" which is not mentioned, nor even hinted at, in the patent?

Objected to as improper cross-examination, the witness having described over and over again not only the particular automatic operation referred to in the question, but all the other operations of the device and its different parts.

A. I feel that I have, as I have had several years' experience with valves, that is, with quick-action valves, and I believe my statement of the device to be a truthful one as to the operation of the complainants' quick-action triple valve.

X 167 Q. Please quote the passage of the specification of patent 360,070, if any such passage there is, which you think, in the slightest particular, warrants or justifies the following statement made by you in answer 6, to wit:

"To apply the brakes fully with the auxiliary reservoir pressure by the final movement of the piston 12 *a sufficient amount of air is gradually exhausted from the main air pipe to move the piston its full stroke.* This will bring the valve port 35 coincident with the passage 22, and thereby establish communication from the auxiliary reservoir to the brake-cylinder, and fully apply the brakes with the reservoir pressure."

920 I call your attention specially to the portion of your allegation which I have italicised.

A. My understanding is there is no such paragraph or passage in the specification.

X 168 Q. Now, as a matter of fact, there is neither a statement nor even the remotest suggestion, in patent 360,070 that in order to effect *any operation whatever* of the valve mechanism of said patent "a sufficient amount of air is gradually exhausted from the main air pipe to move the piston its full stroke." Am I or am I not correct?

A. My understanding is you are correct.

X 169 Q. It is in evidence in this cause, and, so far as I know, have reason to believe, is not disputed by the defendant, that between 1,500 and 1,800 triple valves like that of patent 360,070 are in regular use in railroad service. Have you any knowledge that in the operation of these triple valves, to effect *any operation whatever*, a sufficient amount of air is gradually exhausted from the main air pipe to move the piston the full stroke?"?

A. I have no knowledge whatever of the 1,500 valves you mention.

X 170 Q. You will now, I presume, admit upon the record that your statement made in answer 6, and quoted by me in X Q. 1, is to wit: "To apply the brakes fully with the auxiliary reservoir pressure by the final movement of the piston 12 a sufficient amount of air is gradually exhausted from the main air pipe to move the piston its full stroke. This will bring the valve port 35 coincident with the passage 22, and thereby establish communication from the auxiliary reservoir to the brake-cylinder, and fully apply the brake with the reservoir pressure," was and is incorrect in failing to specify *primarily and essentially*, the application of the brakes by the admission of air directly from the main air pipe to the brake-cylinder as being the application which is made when the parts of the 921 valve mechanism are brought, by the actuation of the engineers' valve, in such position as "will bring the valve port 35 coincident with the passage 22."

Will you make this admission?

A. My understanding of the valve device is that under certain conditions such an operation as I have described could be performed; but I am perfectly willing to admit that such an operation would not be a usual one, or one that might be necessarily used in practice.

In describing the operation of the valve formed by the port 35 I desire to state, that there may be no misunderstanding about the matter, the following:

In my testimony-in-chief I first pointed out those four valves which form the triple valve proper in order to make perfectly clear to the court what constituted the triple valve as it is understood prior to 1887. I then immediately followed with a description of the auxiliary valve, which was an addition to the triple valve, to perform the additional function of admitting main air-pipe pressure to the brake-cylinder.

In my explanation of how the valves, formed by the port 35 operated, I stated as follows:

"To apply the brakes fully with the auxiliary reservoir pressure by the final movement of the piston 12, a sufficient amount of air is gradually exhausted from the main air pipe to move the piston its full stroke. This will bring the valve port 35 coincident with the passage 22, and thereby establish communication from the auxiliary reservoir to the brake-cylinder, and fully apply the brakes with reservoir pressure."

My object in stating the third operation as I did was to show the means employed in the triple valve to admit the auxiliary reservoir air to the brake-cylinder when the piston had made its final movement or full stroke.

I did not wish to imply that the exact operation I described was material to or essential to the device shown in complainants' patent 360,070, but only used it to show how or by what valve the auxil-

922 iary reservoir air was admitted to the brake-cylinder when the piston would have made its final movement or full stroke.

Therefore, if the description I gave in my answer 6 is likely to be misleading in any particular, I would restate it as follows:

To apply the brakes fully by the final movement of the piston 12, a sufficient amount of air is exhausted from the main air pipe to move the piston its full stroke. This will bring the valve 35 coincident with the passage 22, and thereby establish communication from the auxiliary reservoir to the brake-cylinder through the valve formed by the port 35.

Therefore, to the extent of the correction I have just made, I mis-stated the matter.

Answer objected to by counsel for complainant, as not in anywise responsive to the question.

Adjourned to Tuesday, May 9th, 1893, at 9.30 o'clock a. m.

MAY 9TH, 1893—9.30 o'clock a. m.

Met pursuant to adjournment.

Parties present as before.

X 171 Q. X Q. 170 repeated, and the witness is advised that he may, if he pleases, consider it as bearing just as fully on the restatement made by him in his last preceding answer as on his original statement in answer 6.

A. My understanding of the valve device is that under certain conditions the valve could be operated to admit air from the auxiliary reservoir to the brake-cylinder through the port 35, as stated in my 6th answer. At the same time I admit that such an operation would not be a usual one or one that might be necessarily used in practice. In my answer 6 I used that mode of explanation in order to show distinctly those valves that formed the triple valve. However, it is immaterial what the operation of the valve may be, that is to say, whether the main air-pipe air is admitted
923 taneously with the admission of the auxiliary reservoir air to the brake-cylinder through the port 35, or not, as under

this condition the valve formed by the port 35 is one of the triple valves, because in admitting the auxiliary reservoir air to the brake-cylinder it performs a triple-valve function.

Same objection.

X 172 Q. You refuse, then, to make the admission asked for in X Q. 170, do you?

A. As a whole, I do; because in several of my preceding answers I have stated how the air from the auxiliary reservoir could pass to the brake-cylinder through the port 35 without the air being admitted from the main air pipe through the auxiliary valve 41 to the brake cylinder.

X 173 Q. In the hope of bringing you to the knowledge that you are simply piling one error upon another, in declining to avail yourself of the opportunity offered you to correct your previous testimony, I now ask you to point out *any one* of your preceding answers in which you have stated how the air from the auxiliary reservoir could pass to the brake-cylinder through the port 35 without air being admitted from the main air pipe to the brake-cylinder, when "a sufficient amount of air is gradually exhausted from the main air pipe to move the piston its full stroke," as in your allegation quoted in X Q. 170?

A. Not understanding your X Q. 170 at first as fully as I do now, I admit that that part of my statement about the *gradual* discharge of air from the main air pipe by the engineer's valve, to fully apply the brakes with auxiliary reservoir pressure, was incorrect, and in making that statement it was with the intention to show the function of the valves formed by the port 35 when the piston had made its final or full stroke.

Recess.

X 174 Q. In view of what I presume you will not hesitate
924 to admit to be the impossibility of getting main air-pipe air into the brake-cylinder *after* the brake-cylinder has been charged with reservoir air, you are also incorrect, are you not, in stating, in answer 171, that it is immaterial whether the main air-pipe air is admitted through the auxiliary valve 41 to the brake-cylinder simultaneously with the admission of the auxiliary reservoir air to the brake-cylinder through the port 35, or not?

A. As to the first part of your question, I should say that it was an impossibility to get the main air-pipe air into the brake-cylinder, after the brake-cylinder had been charged with sufficient pressure from the auxiliary reservoir to prevent the admission of the main air-pipe air.

As to the second part of your question, I consider it immaterial whether the main air-pipe air is admitted to the brake-cylinder simultaneously with the admission of auxiliary reservoir air or not, so long as the amount of air from the auxiliary reservoir admitted to the brake-cylinder is sufficiently restricted not to interfere with the admission of main air-pipe air to the brake-cylinder.

X 175 Q. Still referring to the *kind* of application of the brakes

which would be effected when auxiliary reservoir pressure is admitted to the brake-cylinder through the valve port 35, you are also incorrect, are you not, in illustrating said port 35 in drawings Nos. 1, 3, 5 and 7 of Defendants' Exhibit Illustrative Cuts Nos. 1 to 10, inclusive, as *larger* than the port controlled by the graduating valve 29 when patent 360,070 distinctly shows the port 35 to be materially *smaller* than the port controlled by the graduating valve 29?

A. As compared with the patent, the size of the port 35 is larger in the cuts than in the drawing of the patent; however, my object in using the cuts was to show the *functions* of the different valves, and not the capacity of them. Had I noticed that the port 35 in the cuts was larger in comparison than the graduating port, I would have had it made to correspond with the proportions shown in the patent, as I have no object in showing it otherwise.

X 176 Q. I do not desire to intimate that you had any improper object in doing what you did, and am only inquiring as to the correctness of your statements and illustrations. I understand from your answer to X Q. 175 that you mean to answer that question in the affirmative and without qualification. Is this the fact?

A. It is.

X 177 Q. You are also incorrect, are you not, in omitting to illustrate by a blue line, in drawing No. 5 of Defendants' Exhibit Illustrative Cuts, the course of the air from the main air pipe to the brake-cylinder through the port uncovered by the valve 41, in the same manner as such traverse of main air-pipe air is illustrated in drawing No. 7?

A. No, I am not, as I used cut No. 5 *only* to show the course of the auxiliary reservoir air to the brake-cylinder when passing through the port 35, in my answer to question 9.

X 178 Q. Do you pretend to say that with the parts in the position shown in drawing No. 5, main air-pipe air would *not* pass to the brake-cylinder in the course substantially as indicated by the blue line in drawing No. 7?

A. No, I do not, provided the air was in the main air pipe with sufficient pressure to pass to the brake-cylinder. I did not use cut 5, or testify to it, other than to show the course of the air from the auxiliary reservoir to the brake-cylinder; nor did I intend to represent the complete operation of the valve, such as when producing a quick action, or otherwise.

X 179 Q. What you *did* use drawing No. 5 for was to attempt to illustrate the performance of an alleged function of patent No. 360,070, recited in your answer 9, under the head of "fourth valve," being the alleged function "3rd" of your answer 6.

Now, in view of your admission that your only warrant for the allegation of said function, is your belief that the device of patent 360,070 *could* perform an alleged "automatic operation," referred to in your answer 159, I ask you whether drawing No. 5 is not misleading and deceptive, in failing to indicate the course of the main air-pipe air, when it pretends to represent the performance of a function as to which in and up to answer

9, and, in fact, up to a comparatively late period in your cross-examination, you did not give the least intimation, was an "automatic operation"?

A. Drawing No. 5 is not misleading or deceptive, as, in using that drawing, I was merely pointing out the functions performed by the valve port 35, and in my answer 9, pertaining to cut 5, I only discussed the function of the valve port 35, irrespective of how it would operate under any condition; and my opinion is that the function of the port is properly stated in said answer 9. It is true that if the cut had been intended to represent the "quick action" of the brake, *then* it should have been provided with a blue line; but it was only used for the *one* purpose of showing the course of the auxiliary reservoir air to the brake-cylinder, and to point out the function of the valve port 35 when the piston had made its final stroke.

X 180 Q. Was or was not drawing No. 5 intended to truthfully and correctly represent the performance of the function which would actually be performed by the device of patent 360,070, when the parts thereof were brought into the position shown in said drawing?

A. Drawing No. 5 was truthfully intended to represent the course of the air from the auxiliary reservoir to the brake-cylinder, and the function of the port 35, when the piston has made its full and final stroke.

Answer objected to by counsel for complainants as not responsive.

X 181 Q. X Q. 180 repeated and a categorical answer requested.

A. Drawing No. 5 was intended to truthfully and correctly represent the performance of the function of the port 35, and the port 35 would perform this function whenever the piston had made its
927 final stroke, provided the pressure in the auxiliary reservoir was greater than in the brake-cylinder.

Same objection.

X 182 Q. X Q. 180 repeated; and, in order to save further needless delay, the witness is requested either to give a categorical answer as asked for, or to say that he refuses to do so.

A. I have stated what I used the cut No. 5 for, and what it is to represent; and having made the best answer I can to the question, I decline to give a categorical answer.

Same objection.

X 183 Q. Does, or does not, drawing No. 5 truthfully and correctly represent the performance of the function which would actually be performed by the device of patent 360,070, when the parts thereof are brought into the position shown in said drawing?

Objected to as improper cross-examination, simply badgering the witness and wasting time. The witness has testified that cut No. 5 was intended to represent *one* of the several functions of the mechanism; that it *does* represent that one and represents it correctly. Having *intended* to illustrate one function, there was no reason why

he should illustrate another and different one; and, moreover, in connection with cut No. 5, the witness submitted cut No. 7 to illustrate *both* functions.

Counsel for complainants again protests against the interpretations of the witness' testimony, and the plain instructions as to what his further testimony shall be, made in the guise of objections by defendants' counsel.

Defendants' counsel says that he intends, by his objection, to call the attention of the court to the badgering character of the cross-examination.

Counsel for complainants submits that if the cross-examination be of such character the intelligence of the court will readily
928 discern it on an inspection of the record, and further that argument as to the character of the cross-examination can be more properly made, and be made with less loss of time, at the hearing than during the taking of depositions.

A. Drawing No. 5 *does* truthfully represent the function of the port 35, but is *not* intended to represent the functions of the other parts, and I desire it to be understood as only representing the function of port 35 when the piston has made its final or full stroke, irrespective of what functions the other parts would or could perform when the parts are in the position as shown on drawing 5.

Same objection.

X 184 Q. X Q. 183 repeated, the witness being requested either to give a categorical answer or to say that he refuses to do so.

Same objection.

A. I have answered the question to the best of my ability and have stated fully what cut 5 was intended to illustrate or demonstrate; therefore I decline to give a categorical answer.

Same objection, and counsel for complainants asks the attention of the court to the witness' persistent refusal to answer the *whole* truth as to the illustration or drawing prepared and submitted by him to the court.

Defendants' counsel submits that the above remarks are grossly improper.

X 185 Q. Referring again to your statement in answer 6, quoted by me in X Q. 167, please explain fully to the court how, if at all, (in view of your answers 142 and 144) it is possible to apply the brakes any more "*fully*," with *auxiliary reservoir* pressure, by the valve mechanism of patent 360,070, when auxiliary reservoir air is caused to pass through the valve port 35 and passage 22 (as in your statement quoted) than they would be applied, with auxiliary reservoir pressure, when auxiliary reservoir air is caused to pass
929 through the port 31, controlled by the graduating valve 29, and the passage 22 (as in your function "2nd" of answer 6)?

A. My understanding of the matter is that the auxiliary reservoir

pressure would not be *more* fully applied to the brake-cylinder through the port 35 than it would be through the port controlled by the graduating valve 29. I have looked over my answers you referred to and I *do not find therein* a statement that the air would be *more* fully applied through the port 35 than through the port controlled by the graduating valve 29.

X 186 Q. Inasmuch as the port 35 is materially smaller in patent 360,070 than the port 31, controlled by the graduating valve 29, if there be any difference in the *fullness* of the application of the brakes by the admission of reservoir air through the port 35, or through the port 31, the brakes would be applied *more* fully by the admission of reservoir air through the larger port 31 than they would be by its admission through the smaller port 35. Is not this correct?

A. My understanding of the device shown in patent 360,070 is that the brakes could not be more fully applied by either of the ports 35 or 31; but my opinion is that the auxiliary reservoir pressure would be applied to the brake-cylinder *more quickly* through the port 31, provided the graduating valve 29 was continuously held open, than it could be through the port 35, because the port 31 is larger than port 35 in the patent.

Adjourned to meet at same place at 9.30 o'clock a. m., May 10th, 1893.

WEDNESDAY, May 10th, 1893—9.30 a. m.

Met pursuant to adjournment.

Parties present as before.

X 187 Q. I understand from your answer 24 that there is no difference in mode of operation, in the performance of the four functions recited in the first paragraph of your answer 9, between 930 defendants' quick-action triple valve, plate IX, defendants' 1889 catalogue, and defendants' quick-action triple valve, plate XI, defendants' 1891 catalogue. Am I correct?

A. There is no difference in the mode of operation between the defendants' two valves shown in the catalogues of 1889 and 1891.

X 188 Q. Could not X Q. 187 have been properly and truthfully answered categorically in the affirmative?

A. I think not; and my reason for stating it the way I did was that in my answer 9 I was comparing the functions of the defendants' quick-action triple valve with complainants' patent 360,070. If your question merely pertains to the functions of the defendants' two valves, 1889 and 1891 catalogues, my answer is yes.

X 189 Q. If you have in anywise misunderstood X Q. 187 I will repeat it, and do repeat it, stating that there is nothing whatever meant or implied in the question, except as to the identity of mode of operation of defendants' 1889 and 1891 valves, in the performance of the four functions which you recite in the first paragraph of answer 9.

Please answer categorically.

A. You are.

X 190 Q. You say in answer 7, referring to defendants' quick-

action triple valve, plate XI, defendants' 1891 catalogue, "I invented this valve device, and it is the outcome of a prior invention of mine which was patented June 26, 1883, No. 280,285."

The "valve device" to which you refer, to wit: defendants' quick-action triple valve, plate XI, defendants' 1891 catalogue, is itself patented in and by your letters patent No. 481,135, August 16th, 1892, a copy of which is in evidence. Is not this the fact?

A. It is.

X 191 Q. And it is also the fact, is it not, that defendants' quick-action triple valve, plate IX, defendants' 1889 catalogue, is patented in and by your letters patent No. 481,134, August 16th, 1892, a copy of which is in evidence.

931 A. It is; and this patent (481,134) contains the broad claims of the invention—patent 481,135 being for the special construction shown in plate XI of defendants' 1891 catalogue.

X 192 Q. It has been admitted by counsel for defendants for the purpose of this suit (see Complainants' Record, page 61) that quick-action triple valves, such as are shown in plate IX, defendants' 1889 catalogue, and described on pages 23 and 24 thereof, were made, sold and used by the corporation defendant prior to the filing of the bill in this cause, said triple valves being used in connection with other members, substantially as indicated in Complainants' Exhibit Drawing Defendants' Quick-action Brake-valve and Connections.

As president of the corporation defendant you will, I presume, admit the substantial correctness of the facts as above stated, and will also admit that such manufacture, sale and use was subsequent to March 29th, 1887, the date of the complainants' patent in suit?

A. I will.

X 193 Q. I understand your statement in answer 8, to wit: "I wish to state here that my 1883 patent was not for a 'quick-action' valve (as that term is now understood)," to refer to your patent No. 280,285 in evidence.

I also understand from your above-quoted statement in answer 8, that your statement in answer 7 that the valve device (plate XI defendants' 1891 catalogue) is the "outcome" of a prior invention of yours, is *not* intended to mean that said valve device (plate XI, defendants' 1891 catalogue) was the "outcome" of, or was the successor to, or was an improvement upon, any prior invention of yours which embodied a valve mechanism designed for, or capable of, use in effecting the application of the brakes with maximum rapidity and force, by the admission of air directly from the main air, or train, pipe to the brake-cylinder, resultant upon reduction of main air, or train, pipe pressure.

Am I correct as to either or both branches of the question?

932 A. As to the first part of your question, you are correct.

You are correct as to the second branch of the question.

In my 1883 patent, I had arranged therein one valve through which air from *both* the main air pipe and auxiliary reservoir would pass to the brake-cylinder, and I embodied this feature in defendants' quick-action triple valve (plate XI, defendants' 1891 catalogue.)

All of the last preceding answer, subsequent to the first sentence thereof objected to by counsel for complainants as not in the slightest degree responsive to the question and as an irrelevant volunteered statement.

X 194 Q. As a matter of fact, said valve device (plate XI, defendants' 1891 catalogue), so far as relates to its design for, or capability of, use in effecting the application of brakes with maximum rapidity and force, by the admission of air directly from the main air, or train pipe, to the brake-cylinder, resultant upon reduction of main air, or train pipe pressure, was the *outcome*, and *directly* the outcome of the prior invention of George Westinghouse, Jr., set forth in patent 360,070 in suit. Is not this the fact?

A. No; it is not the outcome of that patent. It is true I was familiar with the Westinghouse patent 360,070 at the time I designed the defendants' quick-action triple valve; but previous to being familiar with complainants' patent I had made experiments in depleting the train-pipe pressure to quicken the serial application of the brakes.

X 195 Q. You say in answer 8 (referring to defendants' quick-action triple valve and to the triple valve of your patent No. 280,285):

"In both devices train-pipe air (shown by the blue lines) and auxiliary reservoir air (shown by the red lines) enter the triple-valve chamber, and both pass to the brake-cylinder through the same port uncovered by the one valve."

You, however, inadvertently omitted to also state that the *intended* (as well as the *actual*) result is *not* the same in both
933 devices, and that, in defendants' quick-action triple valve, such passage of main air-pipe air and auxiliary reservoir air to the brake-cylinder, effects a "quick-action" or "emergency" application of the brakes, while in the triple valve of patent 280,285, *no application whatever* of the brakes is effected by the passage of main air-pipe air to the brake-cylinder, and no main air-pipe air is admitted to the brake-cylinder until *after* the brakes have been applied, with the maximum rapidity and force within the capacity of the device, *by auxiliary reservoir air alone*.

The statement which I have above recited as having been omitted by you, is absolutely and *unqualifiedly* true, is it not?

A. When I compared the defendants' quick-action triple valve with the device shown in my 1883 patent, my only object was to show that it was common in both devices to admit air from both the train-pipe and auxiliary reservoir to the brake-cylinder *by one valve*. I did not wish to imply, nor do I now, that my 1883 patent was for a quick-action valve such as you have stated. I did not "inadvertently" omit the matter you have suggested, as I considered the same as irrelevant in my answer 8. However, what you say about the 1883 patent is correct.

X 196 Q. Was a triple valve similar to that of your patent No. 280,285, ever put into practice in railroad service, and if so, when, where, for how long and with what results in operation?

A. It was never put in actual railroad service.

X 197 Q. The functions assigned by you in the first paragraph of answer 7 to defendants' quick-action triple valve (plate XI, defendants' 1891 catalogue), designated as 1st, 2nd, 3rd and 4th, and succeeded by the statement, "These four valves form what is commonly known as a 'triple valve' used in the art prior to 1887," correspond, respectively, do they not, with the similarly designated alleged functions, which, in answer 6, you assigned to the valve mechanism of patent 360,070?

934 A. They do.

X 198 Q. Does function "3rd" of the first paragraph of your answer 7, constitute a feature, or an *essential* feature, of operation, of defendants' quick-action triple valve, (plate IX, defendants' 1889 catalogue)?

A. It does.

X 199 Q. Referring you to the description of defendants' quick-action triple valve (plate IX, defendants' 1889 catalogue) found on pages 23 and 24 of said catalogue, it is the fact, is it not, that the *only* "function," or mode of operation, recited in said description of the device, when operating "as a triple valve used in the art prior to 1887," in effecting the supply of auxiliary reservoir air to the brake-cylinder, is the function of admitting said air through the port controlled by the graduating valve (as in function "2nd" of your answers 6 and 7)?

A. It is; but, by inadvertence, a description was omitted in the catalogue as to how, or through what valve, the auxiliary reservoir air was admitted to the brake-cylinder when the piston had made its full stroke.

X 200 Q. It is also the fact, is it not, that the member in plate IX, defendants' 1889 catalogue, which corresponds with what you call the "main valve" 22 of plate XI, defendants' 1891 catalogue, is not even dignified with a symbol of reference in the 1889 catalogue, and is merely termed, in the descriptive matter thereof, "the plug that is integral with the piston 5?"

A. It is the fact.

X 201 Q. Defendants' quick-action triple valve (plate IX, defendants' 1889 catalogue) corresponds, does it not, in all substantial particulars of construction and operation, with the quick-action triple valve described and shown in your patent 481,134, in evidence?

A. It does.

X 202 Q. Referring you to said patent 481,134, it is the fact, is it not, that the *only* "function" or mode of operation recited therein, of the quick-action triple valve described and shown, when operating "as a triple valve used in the art prior to 1887," in effect-
935 ing the supply of auxiliary reservoir air to the brake-cylinder, is the function of admitting said air through the port controlled by the graduating valve, (as in function "2nd" of your answers 6 and 7)?

A. It is; but on page 2, lines 25 to 28, the valve F is mentioned to open and close communication with the brake-cylinder C¹ from both the auxiliary reservoir R¹ and train-pipe P¹, thus plainly indi-

ing it there until the brakes are applied with the desired force," this passage indicating that in making a service stop the engineers' valve would be placed in said position and held there until the brakes were applied with the desired force, meaning, of course, to stop the train and thereby applying the brakes as set forth in paragraph "to apply the brakes fully (not a quick action)."

Recess.

X 210 Q. "Position 4," specified in the instructions as to manipulation of the engineers' brake-valve, quoted by me from page 37 of defendants' 1891 catalogue, is the position into which the handle of the engineers' brake-valve is moved to cause the quick-action triple valve (plate XI, 1891 catalogue) to perform function "2nd" of your answers 6 and 7, that is, "to apply the brakes by graduation," as specified in the paragraph beginning with those words on page 28 of the catalogue. Is not this the fact?

A. It is, as it is also the position to apply the brakes fully (not by a quick action,) the different actions of the triple valve being produced by intermittingly discharging the air from position 4 to graduate the brakes, and the continuous discharge from position 4 to fully apply the brakes (not a quick action.)

X 211 Q. And said "position 4" is indicated in plate V, defendants' 1891 catalogue (illustrating the engineers' brake-valve,) and is there marked "graduating position," is it not?

939 A. Yes.

X 212 Q. Is any position specified in the instructions as to the manipulation of the engineers' brake-valve in defendants' 1891 catalogue, or indicated on plate V thereof, for the performance of function "3rd" of your answers 6 and 7, that is, "to apply the brakes fully (not a quick action,)" as specified in the paragraph beginning with those words on page 28, defendants' 1891 catalogue?

A. There is not.

X 213 Q. Would it be possible, in your opinion, to provide a definite "position" or "graduated stop," (as so termed in defendants' 1891 catalogue, page 15,) for the engineers' brake-valve, by a movement of the valve handle by which the engineer could, in practice, effect the opening of the valve 22 of defendants' quick-action triple valve (plate XI, defendants' 1891 catalogue) sufficiently to effect a greater or more rapid flow of air from the auxiliary reservoir to the brake-cylinder than is effected through the graduating valve port, *without* effecting a quick-action application of the brakes?

A. Yes; it could have been indicated by making "graduating positions" read "graduating position or full service stop."

X 214 Q. If you think, and I understand you do, that such definite positions, or graduated stop, could be provided, would it be correct for trains of different lengths; or, in other words, would not such reduction of main air-pipe pressure as would be made when the handle is placed in such position, which might effect the opening of the valve 22 *without* effecting a quick-action application on a train of a certain length, entirely fail to do so, on a *longer* train,

and undoubtedly effect a quick-action application on a *shorter* train?

A. The valve is so constructed that it will not effect a quick application on a train consisting of one car and a locomotive, so long as the handle remains in position 4. I should, say, however, that on a very long train, say fifty cars, there would not be sufficient air discharged in a given time to unseat the valve 22, especially on the latter part of the train.

X 215 Q. I am satisfied that you have no intention of evading a full and fair answer to X Q. 214, but I do not think that you have fairly understood it. I, therefore, repeat it, and, in case you think you have understood it, ask you to give it a little more thought and see if you have not been far above the mark in specifying a train of fifty cars, and much below the mark in specifying a train of one car and a locomotive.

A. I think I fully understand the question; and as to the quick action on a train of one car and a locomotive, I am satisfied I am correct, because I have tried the same, and in fact every engineers' valve manufactured by our company is tested to see that it does *not* give a quick action to the brake on a train consisting of one car and a locomotive. As to the non-opening of the valve 22 on a long train, I have never made any tests to ascertain just on what car valve 22 would cease to be unseated. It may be ten, twenty or thirty, or more—I can't say.

X 216 Q. Is it your opinion that because, by the delicate, careful and comparatively deliberate manipulation which is practiced on a testing rack, you find that it is possible to get the valve 22 off its seat without effecting a quick-action application, it is a reasonable, safe or well-founded assumption that such a manipulation would be a practicable one, or could and would be regularly performed in actual practice in railroad service, with the result of effecting with certainty the alleged full application of the brakes (not a quick action) prescribed on page 28 of defendants' 1891 catalogue?

A. My opinion is that it could, with a careful engineer.

X 217 Q. As I understand defendants' quick-action triple valves of plate IX, defendants' 1889 catalogue, and plate XI, defendants' 1891 catalogue, the *initial* limit imposed upon the flow of air from the auxiliary reservoir to the brake-cylinder, through the valve chamber C, is the area in transverse section of the port B, in the partition surrounding the hollow stem of the piston. Is such understanding correct?

A. It is.

X 218 Q. And it is also the fact, is it not, that so long as an equal area of transverse section is provided in any and every port between the port B and the brake-cylinder, the maximum quantity of auxiliary reservoir air capable of being delivered through said port B, in any given time, will pass from the chamber C to the brake-cylinder as fast as it is delivered to said chamber through the port B?

A. When the air is admitted to the brake-cylinder by the graduating valve, its flow therethrough, under any condition, is less than

that which passes from the auxiliary reservoir through the port B. When the air is reduced in the main air pipe sufficient to cause the valve 22 to slightly unseat, it will open the port formed thereby to a slightly greater extent than the capacity of the port B, thereby admitting auxiliary reservoir air to the brake-cylinder by the unseating of the valve 22.

Answer objected to as not in the slightest degree responsive to the question.

X 219 Q. X Q. 218 repeated, witness' attention being called to the fact that he is not asked anything about the graduating valve, or the valve 22, and is asked specifically as to the capabilities of port areas.

A. If the discharge port between the chamber C and brake-cylinder is of the same area as port B, then I should say you are correct.

X 220 Q. Could not X Q. 218 have been truthfully and correctly answered categorically in the affirmative?

A. It could; and I should have answered it that way if I had understood the question as I do now.

X 221 Q. As you now understand X Q. 218, I repeat it, requesting that you answer it categorically.

A. Yes.

X 222 Q. And it is also the fact, is it not, that in defendants' quick-action triple valve, plate IX, 1889 catalogue, the port
942 controlled by the graduating valve 13 is of *greater* transverse area than the port B (or as marked on said plate *e*)?

A. As shown on plate IX, it is; but, in practice, the port *e* is larger than the port opened by the graduating valve 13 on plate IX.

X 223 Q. So long as the port controlled by the graduating valve is equal to or greater in diameter than the port B (or *e*), *no more* air would pass from the auxiliary reservoir to the brake-cylinder in a given time, by opening a *still larger* port than the port controlled by the graduating valve (as, for instance, the port controlled by the valve 22) than would pass through the graduating valve port. Is not this the fact?

A. It is a fact; but, in practice, the port *e* in plate IX, or B in plate XI, is always larger than the port opened by the graduating valve.

X 224 Q. The relative diameter of the port *e* (or B) and of the graduating valve port is merely a matter of degree, is it not, and has no relation whatever to the operation of the quick-action triple valve (plate IX, defendants' 1889 catalogue,) as described in said catalogue and in your patent No. 481,134, with which, as you have admitted, said valve accords?

A. It is not a matter of degree, but it is essential in the operation of the valve devices that the port *e* (or B) should be larger than the graduating port, and my recollection of the device shown on plate IX, that there were three ports or passages made in the partition

dividing the valve chamber from the piston chamber each the size of the port *e*.

X 225 Q. Please quote fully upon the record any portion of the description of the construction and operation of defendants' quick-action triple valve (plate IX, defendants' 1889 catalogue) existing in said catalogue or in your patent No. 481,134, which states, or even intimates, that the relative diameter of the port *e* (or B) and of the graduating valve port, is in the slightest degree *essential* in the operation of the valve device.

A. I do not find in either of the descriptions referred to a passage or paragraph which states or intimates that the port *e* (or B) should be of a relative size as compared with the port formed by the graduating valve.

Adjourned to meet at same place on Thursday, May 11th, 1893, at 9.30 a. m.

MAY 11TH, 1893—9.30 a. m.

Met pursuant to adjournment.

Parties present as before.

X 226 Q. Would not the quick-action triple valves of plate IX, defendants' 1889 catalogue, and plate XI, defendants' 1891 catalogue, perform the four functions recited in the first paragraph of your answer 9, to wit: "1st, admitting air from the main air pipe to the auxiliary reservoir, ready for use; 2nd, admitting air from the auxiliary reservoir to the brake-cylinder to apply the brakes; 3rd, exhausting air from the brake-cylinder to the atmosphere to release the brakes; and, 4th, admitting air from the main air pipe to the brake-cylinder to deplete the train-pipe pressure, thereby quickening the action of the brakes on the succeeding cars, and also increasing the pressure in the brake-cylinder over that obtainable from the auxiliary reservoir," regardless of whether the port *e* (or B) of said triple valve was made *smaller* or *larger* than the graduating valve port?

I ask you this question more particularly in view of your answers to X Qs. 203 and 225.

A. They would, provided the port or passage *e* (or B) would not be made too large in reference to the passages A (or *b*), or the said ports *e* (or B) be made too small in reference to the port governed by the graduating valve.

X 227 Q. It being the case that said triple valve of defendants' 1889 and 1891 catalogues would perform the 1st, 2nd and 3rd functions recited in answer 9 and X Q. 226, regardless of whether the port *e* (or B) of said valves was made *larger* or *smaller* than the graduating port, please explain:

944 (1) Why, if at all, it is *essential*, in the operation of defendants' quick-action triple valve, plate IX, 1889 catalogue, that the port *e* (or B) should be *larger* than the graduating port, as alleged by you in answer 224?

(2) Why, if at all, it is *essential* in the operation of defendants' quick-action triple valve, plate XI, defendants' 1891 catalogue, that the port *e* (or B) should be *larger* than the graduating port?

(3) What possible utility or advantage (*other than as an auxiliary-valve device for controlling communication between the main air pipe and the brake-cylinder, in effecting a quick-action application of the brakes*) would be found in, or result from the restriction of the graduating port to a less diameter than that of the port *e* (or B) in the triple valves of defendants' 1889 and 1891 catalogues, and the provision of another and larger port, controlled by another valve, 22, *for the passage of reservoir air to the brake-cylinder, in addition to the already existing graduating port?*

A. It is *not* the case that the said triple valve of defendants' 1889 and 1891 catalogues, would or could perform the 1st, 2nd and 3rd functions recited in answer 9, if the port *e* (or B) was smaller than the port governed by the graduating valve. In my answer 226 I stated they could *provided* the port *e* (or B) would not be made too small in reference to the port governed by the graduating valve; meaning, of course, that the port *e* (or B) could be made smaller or larger so long as it was *larger* than the port governed by the graduating valve. The necessity of having the port *e* (or B) larger than the port governed by the graduating valve will be clear in my answers to sections 1, 2 and 3 of your question, which answers are as follows:

Pertaining to part (1). It is absolutely essential that the port *e* (or B) be made larger than the port governed by the graduating valve in the operation of defendants' quick-action triple valve, plate IX, 1889 catalogue, because, if the port *e* (or B) was made smaller than the port governed by the graduating valve the air from
945 the valve chamber would be exhausted quicker than the air from the port *e* (or B) could be supplied to the chamber, thereby reducing the pressure in the valve chamber below that in the main air pipe acting on the under side of the check-valve, and thus venting the main air-pipe air into the valve chamber and thereby causing the piston to move its full stroke and produce a quick application of the brake at the time when it was desired to apply the brakes by graduation.

Part (2.) As part (2) of your question is the same as part one, except that in part (1) it is "*alleged*," and in part (2) it is not alleged, my answer to part (2) is the same as to part (1).

Part (3.) As to part (3) the utility of having the port *e* (or B) larger than the port governed by the graduating valve is—that when it is desired "to fully apply the brake (not a quick action)" the air from the auxiliary reservoir can pass to the brake-cylinder in a less space of time than it could if passed through the smaller port governed by the graduating valve.

X 228 Q. Then, as I now understand you, it *is* essential in defendants' triple valves of the 1889 and 1891 catalogues, that the port *e* (or B) shall be larger than the graduating port in order to effect the 1st, 2nd and 3rd functions recited in answer 9 and X Q. 226. Am I correct?

A. You are.

X 229 Q. The objection alleged by you in answer 227, of effecting a quick application of the brakes, at the time when it was desired

to apply the brakes by graduation, would not obtain or exist, would it, if the port *e* (or B) and the graduating port were of *equal* diameters?

A. It would not, with a careful manipulation of the brake; but in order to insure the "quick action" not taking place when graduating, we always make the port *e* (or B) larger than the graduating port.

X 230 Q. Would not the 1st, 2nd and 3rd functions recited in answer 9 and in X Q. 226 be performed by the quick-action triple valve of defendants' 1889 and 1891 catalogues, if the valve 946 22, and the port controlled thereby were not present in said quick-action triple valve?

A. They would; but the function of admitting auxiliary reservoir air to the brake-cylinder would only be accomplished by the graduating valve by the preliminary movement of the piston, and the quicker application of the brakes would be destroyed, as the main valve of the triple valve would be destroyed.

All of the last preceding answer subsequent to the words "they would," at the beginning thereof, objected to as not in anywise responsive to the question and an irrelevant volunteered statement.

X 231 Q. This being the case, is not the action of said valve 22 *necessarily* supplemental to, or auxiliary to, that of what you call the "graduating valve" of the quick-action triple valve of defendants' 1889 and 1891 catalogues?

A. No; it is not necessarily so, because the graduating valve could be constructed so that it would admit the main air-pipe air to the brake-cylinder. In experiments I have made I have used one valve to perform the graduating function, the main-valve function and the quick-action function.

X 232 Q. It is the fact, is it not, that in defendants' quick-action triple valve (plate XI, defendants' 1891 catalogue), the valve 17, 18, can be moved or operated to perform the 1st, 2nd and 3rd functions recited in answer 9 and X Q. 226, without moving or operating the valve 22?

A. It is; but in performing the 2nd function it would be of the graduating nature.

All of the last preceding answer subsequent to the words "It is," at the beginning thereof, objected to as not in anywise responsive to the question, and an irrelevant volunteered statement.

X 233 Q. It is also the fact, is it not, that the valve 22 controls or governs communication between the main air pipe and the brake-cylinder, and that said valve 22 is actuated by the piston stem of the triple valve?

A. As to the first part of your question it is true when the partition formed by the *bushing* 9 exists in the valve structure, and it is also true that the port governed by the valve 22 also governs the passage of air from the auxiliary reservoir when the piston makes its final movement; as to the second part of your question, it is true.

So much of the last preceding answer as relates to the first part of the question objected to as embodying a qualification which is neither stated nor implied in the plain terms of the question, and as further embodying an irrelevant volunteered statement.

X 234 Q. It is also *absolutely* and *unqualifiedly* the fact, is it not, that the valve 22, of the quick-action triple valve, shown and described in plate XI, defendants' 1891 catalogue, and the descriptive matter relating thereto, controls or governs communication between the main air pipe and the brake-cylinder?

A. It is true; and it is also true that the said valve 22 is never opened for a quick action unless the auxiliary reservoir air passes to the brake-cylinder through the same valve 22.

All of the last preceding answer subsequent to the words "It is true," at the beginning thereof, objected to as not responsive and an irrelevant volunteered statement.

X 235 Q. It is the fact, is it not, that Defendants' Exhibits B and C and drawing No. 10, of Defendants' Exhibit Illustrative Cuts, in which exhibits you say: "I have arranged with the partition and differential passages of the defendants' quick-action triple valve, the slide and graduating valve mechanism of the Westinghouse patent No. 220,556,"—differ from said patent in the particular that the port of said exhibits marked C, "To brake cylinder," in drawing No. 10, is proportionately more than *twice* as large as the port C of patent 220,556?

948 A. It is.

Counsel for complainants states that, as at present advised, he now terminates the cross-examination of Mr. Boyden.

The redirect examination of Mr. Boyden and his recross-examination, if any, are postponed by consent of counsel, it being understood and agreed that the examination-in-chief of Mr. Joseph B. Church shall now be proceeded with (reserving the right of objection to counsel for complainants, who desires to return temporarily to Pittsburg), and that counsel for complainants shall not be called upon to cross-examine Mr. Church nor to attend the further examination of Mr. Boyden, prior to Tuesday next, 16th instant, and that, if the direct examination of Mr. Church shall not be concluded by that time, counsel for complainants shall be so notified by wire, and notified when his presence will be desired.

NOTE.—The testimony of George A. Boyden is continued after the testimony of Joseph B. Church.

JOSEPH B. CHURCH, a witness produced on behalf of the defendant, having been duly sworn, deposes, in answer to interrogatories, and says as follows:

Q. 1. State your name, age, residence and occupation.

A. Joseph B. Church; 40; Washington, D. C., attorney, solicitor and expert in patent causes.

Q. 2. As you are to be examined as an expert, state your qualifi-

cations to testify in that capacity, and especially with reference to air-brake patents and apparatus.

A. For the past twenty-one years I have devoted my attention exclusively to the subjects of inventions, mechanics and patents.

In the year 1872, I entered the Patent Office, where I remained for eleven years, occupying the several positions of assistant examiner, principal examiner and examiner of interferences, which latter office I held at the time of my resignation in August, 1883. During the entire eleven years of my employment in the Patent Office, my duty required me to examine and pass upon questions of novelty, patentability and invention arising in the course of the examination of applications for patents, as well as the consideration, study and understanding of many thousands of patents pertaining to almost all branches of the mechanical arts.

Since 1883, I have been engaged actively in the practice of my profession, and during that time have examined many thousands of patents, prepared and prosecuted applications for patents and furnished opinions concerning the scope and validity of patents, as well as of the alleged or possible infringements of patents. I have frequently been called upon to, and have, given evidence in patent causes, as an expert, both in this country and in Canada. I have frequently had occasion to examine patents pertaining to air and other brake mechanisms, and during the past two years have devoted considerable time to study of the subject, particularly with reference to air-brake patents and apparatus, and have been present and participated in a large number of air-brake tests and experiments conducted or superintended by Mr. George A. Boyden, at the works of the Boyden Brake Company here in Baltimore.

Q. 3. Are you familiar with the several patents and paper exhibits introduced in evidence in this cause?

A. I believe I am.

Q. 4. Have you examined, and do you understand, the various models and mechanical structures heretofore introduced in evidence in this cause?

A. I have examined and believe I fully understand the various models and mechanical structures heretofore introduced in evidence on behalf of the defendants, but have not examined complainants' exhibits, although I believe I am familiar with the structures they represent.

Q. 5. Explain to the court, in a general way, the system which has become known as "the automatic air-brake" system.

Objected to as incompetent, the witness not having been shown to have received any technical education, nor to have had any practical training or experience, either in that branch of the mechanic arts which relates to automatic air brakes, or in any other branch thereof, and being, by his own admission, a mere *student*, and not, in any sense of the words, a practical mechanic, mechanical engineer, or mechanical "expert."

This objection is continued, without further notice, as to the entire line of examination of the witness as an expert.

A. The automatic air brake is one of a class of brake mechanism known as "continuous," in that each car of a train is equipped with its own special brake-actuating devices, and the several brake-actuating devices of a train are so connected or united that the entire series may be operated together, and the brakes applied to all the cars comprising the train.

As the name indicates, air is the motive power employed in this system for effecting the application and release of the brakes, and as there are two or more distinct varieties or classes of air brakes, the word "automatic" is employed to designate that particular class in which special provision is made for automatically effecting the application of the brakes to a car when it becomes accidentally detached or uncoupled from the balance of the train, or when the conduit through which fluid pressure is supplied to the series of brake mechanisms is ruptured or otherwise accidentally impaired.

One of the essential distinctions between what is known as the "straight-air" or non-automatic air brake, and the "automatic" air brake, is the capacity of the latter for automatically effecting the application of the brakes to a car when the latter becomes detached or the train broken in two, and this feature or capacity
951 for automatic action is due to the difference in the principle upon which the motive power is supplied and utilized both in applying and releasing the brakes.

Adjourned to meet at same place Friday, May 12th, 1893, at 10 o'clock a. m.

10 O'CLOCK A. M., *May 12th, 1893.*

Met pursuant to adjournment.

(Mr. CHURCH resumes:)

A. In the non-automatic or straight air-brake system, the air pressure for actuating each brake piston is transmitted from the locomotive through a train-pipe; and delivered directly into the brake-cylinders of the several cars where it becomes active in applying the brakes. To release the brakes, the pressure of air in the train-pipe is relieved. When a car is detached from the air compressor, which furnishes the power for actuating the pistons in applying the brakes, no means are afforded for arresting the detached car or cars.

In the automatic air-brake system, a very different principle is introduced. In this, each car is provided with an independent reservoir for the storage of compressed air, delivered through the train-pipe, the air thus stored being employed for applying the brakes; and the admission of the reservoir air to the brake-cylinders in applying the brakes, is effected through a reduction of pressure in the train-pipe while the discharge of air from the brake-cylinder, to release the brakes is effected by restoring the pressure in train-pipe. In this system, "the automatic air-brake system," the train-pipe serves as the conduit through which the reservoirs under each

car are charged with air pressure, and so long as the maximum pressure is maintained in the train-pipe, the brakes are held off; but when the pressure in the train-pipe is lowered or withdrawn, either intentionally or by accident, the connection between the train-pipe through which the reservoir was charged is automatically closed, the exhaust from the brake-cylinder to the atmosphere is closed, 952 and communication between the reservoir and the brake-cylinder is opened, so that the compressed air in the reservoir expanding into the brake-cylinder will effect the application of the brakes.

The mechanism through which this result or effect is produced and made possible is known as a "triple valve," for the reason that it is arranged to control or effect three distinct lines of communication, one between the train-pipe and reservoir, through which the reservoir is charged with air under pressure; a second between the brake-cylinder and the atmosphere, through which the air is exhausted or allowed to escape when the brakes are released; and a third between the auxiliary reservoir and the brake-cylinder, through which the air is conducted for actuating the brakes.

The essential elements of the automatic air-brake system, so called, are the following:

1st. An air compressor or source of air supply, usually located upon the engine, and comprising an air pump and main air reservoir.

2nd. A main air or train pipe, formed in sections, of which each car is provided with one section, and the several sections are adapted to be connected in series to form a continuous conduit, whose rear end is closed.

3rd. Means for opening and closing communication between the source of air supply and main air or train pipe, and between the latter and the atmosphere, for controlling the pressure of air in the main air or train pipe, such means being commonly known as the engineers' valve.

4th. A reservoir, termed an "auxiliary reservoir," on each car, in which compressed air, delivered through the main air or train pipe is received and stored, and from which the air is drawn to actuate the brake mechanism.

5th. A brake-cylinder on each car with connections for transmitting the motion and pressure of the piston to the brake-shoes.

6th. A valve mechanism termed a "triple valve" connected to the main air or train pipe, the auxiliary reservoir 953 and the brake-cylinder, and controlling the flow of air from the train-pipe to the auxiliary reservoir, from the auxiliary reservoir to the brake-cylinder, and from the brake-cylinder to the atmosphere.

There are various forms and modifications of the automatic air-brake mechanism, but the system I have described is the one best known and generally used in this country. Its characteristic features are the delivery to and storage upon each car of a supply of air under sufficient pressure to actuate the brake mechanism; the maintenance of the supply of air in the auxiliary reservoirs, and

the holding of the brakes released by the pressure of air in the train-pipe; the controllable application of the brakes by a reduction of pressure in the train-pipes, when such reduction is produced and controlled by the engineer; and the automatic application of the brakes by the accidental reduction of pressure in the train-pipe caused by accident or imperfections such as would affect the proper operation of the brake mechanism as a whole.

An example of what I have termed the straight-air or non-automatic system is to be found in patent No. 88929, granted to G. Westinghouse, April 13th, 1869; and in patent No. 124,404 to the same party, and dated March 5th, 1872, is illustrated one of the earliest forms of the automatic features of the air-brake system, applied in connection with the "straight-air" or non-automatic system, that is to say, it exhibits an air-brake mechanism in which the application of the brakes is effected primarily and usually by the introduction of air under pressure from one train-pipe, and, in addition thereto, an auxiliary reservoir, supplied with air through a second air pipe, is provided for each car, with suitable valves, to be brought into action when the car is derailed or separated from the balance of the train, for automatically effecting the transmission of air from the auxiliary reservoir into the brake-cylinder, and thus effect an automatic application of the brakes.

954 In the full development of the automatic air-brake system, the "straight" or direct application of pressure to the brake-cylinders through the train-pipe was omitted, and the auxiliary reservoir air alone was employed for charging the brake-cylinders, the application and release of the brakes being effected through the medium of the triple-valve mechanism and variations of pressure in the train-pipe.

Q. 6. Explain the important steps in the evolution of the "triple valve," in the air-brake art, down to the date of patent 360,070 here in suit.

A. The triple valve constituted one of the most essential and distinguishing features of what is known as the automatic air-brake system, it being the element responsive to the fluctuations of pressure in the main air or train pipe (for convenience I shall hereafter use the term "train-pipe" alone to designate the pipe or conduit through which air is transmitted from the compressor or source of supply to the brake mechanism of each car) and operating to control the admission of train-pipe air to the auxiliary reservoir, the admission of auxiliary reservoir air to the brake-cylinder, and the escape of air from the brake-cylinder.

In its earliest and most primitive form, the triple valve was composed of a casing containing a piston chamber or cylinder; a piston, three valve devices, and four connections or passages, one leading to the train-pipe, a second to the brake-cylinder, a third to the auxiliary reservoir and a fourth to the atmosphere. The form and arrangement of the several parts varied greatly, but the general construction was the same, and the operations performed were substantially identical.

The piston was subjected to two opposing air pressures, that is to

say, the piston chamber communicated at one end with the train-pipe, and at the other or opposite end with the auxiliary reservoir.

One valve controlled a passage leading from the train-pipe side of the piston to the auxiliary reservoir, and the arrangement was such that this passage would be opened when the piston, 955 under the influence of train-pipe pressure, was at one extreme of its movement, so that train-pipe air would pass into the auxiliary reservoir, raising the pressure in the latter to that in the train-pipe. This feed-opening between train-pipe and auxiliary reservoir was closed at the beginning of the return stroke of the piston, thus preventing the return of air from the auxiliary reservoir into the train-pipe.

Another of the three valve devices mentioned controlled the passage between the brake-cylinder and the atmosphere, and it was arranged to open said passage when the piston was forced out or away from the train-pipe end of its cylinder, and while the feed-opening into auxiliary reservoir was uncovered or opened. Thus with train-pipe air at maximum pressure, the piston would be operated to uncover the feed-opening into the auxiliary reservoir, and, at the same time, open the exhaust from the brake-cylinder.

The third valve device, controlling the passage from the auxiliary reservoir to the brake-cylinder, was opened only when the piston was retracted or drawn towards the train-pipe end of its cylinder or chamber, and after the feed-opening into auxiliary reservoir and the exhaust opening from brake-cylinder had been closed, so that air from the auxiliary reservoir would flow into the brake-cylinder and effect the application of the brakes.

The movement of the piston to effect these several changes in the relations of the valve devices was produced by variations of pressure on its opposite faces, one face being subjected to train-pipe pressure, and the other to auxiliary reservoir pressure, and the direction of motion of the piston depended upon the preponderation of pressure on either face. Thus, if the pressure exerted by train-pipe air on the piston exceeded that of the auxiliary reservoir air, the piston would be moved away from the train-pipe side, opening the escape port or passage of the brake-cylinder, to release the brakes and opening the feed port or passage, to charge the auxiliary reservoir.

If, now, the pressure of air in the train-pipe was reduced 956 below that in the auxiliary reservoir, the piston would be forced towards the train-pipe side and effect the application of the brakes by closing communication between the brake-cylinder and the atmosphere, and opening communication between the auxiliary reservoir and brake-cylinder.

Illustrations of triple valves such as I have referred to, but each differing in minor details of construction, are found in the following patents:

No. 141,685, granted to G. Westinghouse, Aug. 12, 1873.

No. 144,006, " " G. Westinghouse, Oct. 28, 1873.

No. 166,386, " " W. D. Jones, Aug. 3, 1875.

No. 166,405, " " H. L. Perrine, Aug. 3, 1875.

No. 168,359, " " G. West'gh'se, Jr., Oct. 5, 1875.

The last-named patent (No. 168,359) may be taken as illustrating one of the most improved forms of the triple valve as it existed in 1875.

It was not at all times required, nor desirable, when making an application of the brakes, to apply them with the full power of the auxiliary air, such as would necessarily result from a considerable reduction of pressure in the train-pipe, and the consequent full opening of the passage between the auxiliary reservoir and the brake-cylinder. This action necessarily took place when the automatic feature was brought into play, as when the train broke in two, or the train-pipe was ruptured; and when it was required to stop the train in the shortest possible time, as in an emergency. For ordinary stops and when slowing down, as on a downgrade, it was desirable that only a moderate degree of braking force be exerted, and that this might be controlled from the engine; hence provision was made whereby, by a relatively slight reduction of pressure in the train-pipe, the triple valve would be actuated to admit a limited amount of air from the auxiliary reservoir, and upon the pressure on auxiliary reservoir side of piston being diminished by expansion into the brake-cylinder, the piston would move to close the passage between auxiliary reservoir and brake-cylinder without, however, moving sufficiently to open the exhaust and feeding passages. When a limited amount of pressure
957 had thus been developed in the brake-cylinder it could be retained or augmented at will.

This operation of applying the brakes with less than maximum power, or by an intermitting action, is known as "graduating," to distinguish it from the automatic or full application of the brakes in the shortest possible time and with the maximum power, as in making an emergency stop.

The triple valve of patent 168,359, dated October 5, 1875, is provided with a piston working in a cylinder and subjected to train-pipe air pressure on one side and auxiliary reservoir air on the other. Communication between the train-pipe and auxiliary reservoir for feeding the latter is made through a small passage opening into the cylinder just below the piston, said passage being closed by the piston at the commencement of its stroke towards train-pipe. This is the feeding valve and passage.

The piston stem carries a slide-valve arranged to perform two valve functions, *i. e.* that of controlling the exhaust from brake-cylinder and controlling the passage from auxiliary reservoir to brake-cylinder.

When the train-pipe pressure is reduced the piston is forced back by the preponderating auxiliary reservoir pressure, thereby closing feed-passage and exhaust, and uncovering passage from auxiliary reservoir to brake-cylinder.

On the train-pipe side of the piston, and in line with the latter, is located a stem upheld by a spring. When the piston is retracted by a reduction of train-pipe pressure it first closes exhaust from brake-cylinder, and, before opening the passage from auxiliary reservoir to brake-cylinder, it encounters the spring-supported stem.

The further movement of the piston will be arrested until the preponderance of auxiliary reservoir air pressure is sufficient to overcome the spring, when the valve will be operated to open to a greater or lesser degree the passage between auxiliary reservoir and brake-cylinder and effect an application of the brakes.

958 As soon as the pressure of auxiliary reservoir air has been diminished below that exerted by the train-pipe air and spring combined, the piston will, by the spring, be moved back to close the passage between auxiliary reservoir and brake-cylinder, without, however, opening the exhaust, and the brakes can thus be held on with a pressure proportionate to the reduction made in the train-pipe. A further increase of pressure in the brake-cylinder can be effected by again reducing the pressure in train-pipe, the spring operating each time to afterwards shift the valve and close the induction passage to the brake-cylinder.

The spring-supported stem is useful only in "graduating," for when full pressure in shortest time for an emergency stop is required, or the triple valve is caused to exert the automatic function, it is requisite that the piston should be given its full stroke and held so that the main valve will fully uncover or open the passage from auxiliary reservoir to the brake-cylinder.

The next important improvement that I will notice was designed to facilitate the closing of the feed-passage by the first motion of the piston, and before the valve controlling the passage between the auxiliary reservoir and the brake cylinder was started. It is illustrated in patent No. 172,064, granted to G. Westinghouse, Jr., January 11, 1876, and consists in locating the valve between shoulders on the piston stem, so as to permit of a limited motion of the piston before engaging the valve. The independent motion allowed the piston is sufficient for closing the feed-port and preventing the auxiliary reservoir air from flowing back to the train-pipe when the pressure in the latter is lowered, as in effecting an application of the brakes.

The triple valve arrived at full development when it assumed the form and construction illustrated and described in patent No. 220,556, October 14, 1879, and so far as I am advised, this patent discloses the "triple valve" most commonly known and used at and prior to the date of patent 360,070.

959 In the general features of construction the triple valve of patent 220,556 accord in all particulars with patents 168,359 as improved in patent 172,064; that is to say, the casing with its piston chamber, valve chamber and air passages is the same, as is also the stem and its spring (denominated the "graduating spring"), the feeding valve and the main valve, the latter arranged to be engaged by shoulders on the piston stem, as in patent 172,064.

The invention and improvement of this patent (No. 220,556) consist in the addition of what is termed in the patent "an auxiliary valve," controlling a passage between the auxiliary reservoir and brake-cylinder for performing a portion of the functions previously performed by the main valve, *i. e.*, those incident to graduation.

This auxiliary valve is located within a passage in the main valve

to which it is auxiliary, and it is connected to move with the piston, whereby it is permitted a slight motion independent of the main valve, the latter remaining stationary until engaged by one of the shoulders on the piston stem.

The passage in the main valve controlled by the auxiliary or "graduating" valve, as it is termed, opens at one end into the valve chamber and terminates at a point on the face of the main valve below the upper edge thereof, and in line with the passage leading to the brake-cylinder.

Although in the patent the added element by which "a portion of the functions" previously performed by the main valve is described as "an auxiliary valve," I shall hereinafter refer to it as the "graduating valve," by which name it has since been generally known.

The operation of the improved triple valve of this patent I understand to be as follows:

When operated automatically or in effecting an emergency stop, that is, applying the maximum pressure in the shortest possible time, the new graduating valve was not brought into effective action, the main valve H performing its usual functions of uncovering port C, and permitting a free passage for auxiliary reservoir air to the brake-cylinder. This operation is performed precisely as with the triple valves of patents 168,359 and 172,064, and results whenever the pressure in train-pipe is reduced to such a degree that the piston will make its full stroke towards the train-pipe end of the cylinder.

The graduating valve is only brought into action for effecting a graduated application of the brakes, and in so doing it performs those functions of the main valve H of the prior patents which related to graduating, *i. e.*, the intermitting or gradual increase of pressure in the brake-cylinder.

When the pressure on the train-pipe side of the piston is slightly reduced, so that the piston will respond to the difference of pressure on the auxiliary reservoir side, the main valve H is brought down until the motion of the piston is arrested by contact with the graduating stem, at which point the port *s'* in valve H will stand partially or wholly in communication with port C leading to the brake-cylinder, and the graduating valve having been opened at the beginning of the stroke of the piston before the upper shoulder engaged the main valve, an open passage is formed through which auxiliary reservoir air is conducted to the brake-cylinder and there operates to apply the brakes.

4.30 p. m.—Adjourned to meet at same place at 10 o'clock a. m., May 13th, 1893.

SATURDAY, May 13th, 1893—10 o'clock a. m.

Met pursuant to adjournment.

(Mr. CHURCH, continuing :) As soon, however, as the pressure of auxiliary reservoir air in piston chamber is reduced (by expansion in the brake-cylinder) below pressure of train-pipe air, the piston

will move slightly, to close graduating passage, but without shifting the main valve, and the brakes will be held on.

To increase the pressure in brake-cylinder by graduation, 961 the pressure in train-pipe is again lowered, when the graduating valve will be again unseated and air fed to the brake-cylinder until the reduction of pressure on auxiliary reservoir side falls below train-pipe pressure, when the graduating valve will again close. Thus by gradual and periodical reductions of pressure in train-pipe, the pressure in brake-cylinder is controlled—a result previously effected through the medium of the main valve alone—but, in the present instance, with much greater certainty and delicacy of adjustment, owing to the fact that the graduating valve alone has to be moved instead of the main valve after the latter has been first brought into position.

By the addition of the graduating valve to perform the operations of opening and closing communication between the auxiliary reservoir and the brake-cylinder, in making graduated applications of the brake, the functions of the main valve H were diminished in part, but not entirely suppressed, for it still continued to be the effective means *for applying full reservoir pressure in the shortest time*, by opening a direct passage to the brake-cylinder.

The valve mechanism controlling the passage of auxiliary reservoir air to the brake-cylinder is here divided into two parts, one being brought into action when graduating, and the other when making an emergency stop or an automatic application of the brakes.

In thus attributing to the main valve H the function and operation of the corresponding valve of the earlier structures, I have not overlooked the fact that no specific description is given in the patent (220,556) of the operation performed when an *emergency* or automatic application of the brakes is to be effected; but I have not the slightest hesitation in stating it as my opinion and understanding that such is the case, for the following among other reasons:

In the first place, the mechanism of the patent is substantially the same as that of patent No. 172,064, with the exception of the added "graduating valve," and it is arranged and adapted to perform all the operations of the prior triple valve, with the 962 single exception that the graduating function of the main valve is transferred to the graduating valve.

In the second place, the structure of the triple valve shown is such that a considerable reduction of pressure on the train-pipe side of the piston, or the withdrawal of all pressure on that side, must of necessity cause the piston to retract the graduating stem, thus carrying the main valve beyond the graduating position and causing it to make a full stroke, which would uncover the port C leading to the brake-cylinder and apply full reservoir pressure in the shortest space of time.

In the third place, the graduating valve is not described as supplanting the main valve H in controlling the passage of air from auxiliary reservoir to the brake-cylinder, but merely as performing "a portion of the functions" of said main valve as previously used,

and the only portion of the functions thus performed are such as are incident to "graduating" and not to *full* pressure.

In the fourth place, the valve H is denominated "the main valve," and the graduating valve "an auxiliary valve," by which I understand is intended to be meant *auxiliary* to the main valve in controlling the flow of air to the brake-cylinder.

In the fifth place, the description of the operation of the device is limited to the improvement effected by the transference of the graduating functions of the main valve to the graduating or "auxiliary valve."

In the sixth place, in all patents and publications in which the operation of this improved triple valve is described, so far as I have been able to find, it is generally recognized and accepted as performing the two classes of operations involved in making graduated and full, or emergency stops, the first through the medium of the graduating valve, and the second through the medium of the main valve uncovering the port C leading to the brake-cylinder. Thus, in the Westinghouse patent No. 235,922 of December 28, 1880, the triple valve of patent No. 220,556 is shown, and in describing its operations, it is said that by the shifting of main valve H, the latter is caused "to uncover the port C." In the Knee-963 land patent No. 251,383, of October 26, 1886, in which the triple valve of patent 220,556 is shown in connection with other improvements, its action when used "to apply the brakes with their full force" is said "to permit air to flow directly from the auxiliary reservoir A' into brake-cylinder A 2'", in contradistinction to the flow of the auxiliary reservoir air through the graduating passage in the main valve, when operated "to apply the brakes gently." Again, in the description of the triple valve of patent 220,556, contained on pages 10 and 11 of complainants' 1886 catalogue, under the title "triple valve, reservoir and cylinder," the following description is found:

"To apply the brakes with their full force the compressed air in the main brake-pipe is allowed to escape when the greater pressure in the auxiliary reservoir forces the piston 5 down below the feeding groove, thus preventing the return of air from the reservoir to the brake-pipe. As the piston descends it moves with it the slide-valve 6, so as to permit air to flow directly from the auxiliary reservoir into the brake-cylinder, which forces the pistons out and applies the brakes. The brakes are released by again admitting pressure into the main brake-pipe from the main reservoir, which pressure being greater than that in the auxiliary reservoir, forces the piston 5 back to the position shown in the drawing, recharges the reservoir, and at the same time permits the air in the brake-cylinders to escape. To apply the brakes gently, a slight reduction is made in the pressure in the main brake-pipe, which moves the piston down slowly until it is stopped by the graduating spring 9; at this point the opening *l* in the slide-valve is opposite the port *f*, and allows air from the auxiliary reservoir to feed through a hole in the side of the slide-valve and through the opening *l* into the brake-cylinder. The passage *l* is opened and closed by a valve 7,

964 which is attached to and moves with the piston 5, provision being made for a limited motion of these parts without moving the valve 6. When the pressure in the auxiliary reservoir has been reduced, by expansion in the brake-cylinder, until it is the same as the pressure in the main brake-pipe, the graduating spring pushes the piston up until the small valve 7 closes the feed-opening *l*. This causes whatever pressure is in the brake-cylinder to be retained, applying the brakes with a force proportionate to the reduction of pressure in the brake-pipe."

On pages 38 to 40, inclusive, of the same catalogue, in describing the construction and operation of the engineers' brake-valve, namely, the valve on the engine by which the engineer controls the application and release of the brakes, directions are given for effecting the two classes or kinds of brake-application above referred to, the one involving the sudden application of the brakes with full power by a rapid or total reduction of pressure in the train-pipe, and the other involving the gradual application of the brakes, as in graduating or making ordinary stops, this latter being effected by the gradual and partial, or intermitting, reduction of pressure in the train-pipe.

I have also in my hand another book purporting to be issued by the complainant company, entitled "Instruction Book," and bearing imprint date 1886. As indicating the scope and purpose of this work, I quote the following from the preface:

"Our attention has been repeatedly directed to the importance of furnishing a complete and concise description of our brake apparatus, to be placed in the hands of those who are engaged in its operation or its maintenance."

This book contains substantially the same description of the triple valve previously quoted from the catalogue of 1886, and in addition thereto the following statements, clearly indicating the two different kinds of brake-application:

965 "Too much importance cannot be attached to that portion of the instruction stating that engineers should use care and moderation in applying the brakes for ordinary stops. By applying them at a fair distance from the station, with moderate force, the train is stopped gently and without inconvenience to the passengers, while if they are thrown on with the utmost force possible, the train is jerked in a manner that is extremely disagreeable to the passengers."

The triple valves of both the 1886 catalogue and the 1886 instruction book are the same as the triple valve of patent No. 220,556.

To summarize the development of the triple valve as I have outlined it, and starting with patent 168,359 containing the piston, graduating stem, feed-valve, exhaust valve, and a main valve, the latter operating to effect both graduated and full applications of the brake accordingly as the train-pipe pressure was reduced slightly or considerably, the first step of any consequence in its further development was the provision for a limited movement of the piston independently of the main valve, shown in patent No. 172,064, of January 11, 1876, and the subsequent addition of an "auxiliary"

to the main valve for performing part of the functions of the latter, to wit: those incident to graduating, as explained in patent No. 220,556, of 1879.

I may here remark that in applying the graduating valve to the main valve, as in patent 220,556, two valves are in fact introduced for effecting graduation; thus the port *s'* in main valve H co-operates with the port C to open and close communication between the auxiliary reservoir and the brake-cylinder, while the graduating valve *e'* serves to open and close communication between the auxiliary reservoir and said port *s'*. Both valves must be open simultaneously to effect the admission of auxiliary reservoir air to the brake-cylinder, and if either is entirely closed auxiliary reservoir air will be prevented from passing through the graduating devices to the brake-cylinder.

The function of opening and closing the escape from the
966 brake-cylinder to the atmosphere is performed by a part of the main valve, as in the prior patents referred to.

Q. 7. Explain what is known in the air-brake art as "quick action;" the reason why quick action is desirable, and the important steps in the evolution of "quick action" down to the date of patent No. 360,070, here in suit.

A. The term "quick action" as applied to air brakes, is, as I understand, employed in a general way to designate a system in which the application of the brakes on all the cars composing the train is effected simultaneously, in the shortest possible time and with the maximum braking force, but it has more recently been adopted to specifically define an automatic air-brake system in which provision is made for venting the train-pipe at intervals in its length, in order that train-pipe pressure may be quickly reduced throughout the entire length of the train-pipe, and the triple valves be caused to act simultaneously, or as nearly so as possible, to apply the maximum braking force upon each car composing the train. The *quick-action* operation is brought into play only in cases of emergency, when a sudden stoppage of the train is rendered necessary. The quick action referred to corresponds generally with the full pressure or emergency stop of the old forms of automatic-brake appliances, and is distinct from the operations of graduating and making service stops.

In operating the old automatic air-brake system, the train-pipe pressure was depleted or exhausted by the opening of an escape port or valve, on the engine; hence, to effect such a reduction of pressure as was necessary to produce the full stroke of the triple-valve piston and a full application of the brakes, the air had to travel from the rear end of the train-pipe to the engine. The movement of the air in the train-pipe was comparatively sluggish, but sufficiently rapid on relatively short trains to not injuriously affect the braking action; but when it was attempted to apply the automatic air-brake system to relatively long trains of cars, say forty or fifty
967 cars, it was found that the interval between the time of application of the first and last brakes was so great as to result in the production of disastrous shocks, due to the fact that the

brakes were applied progressively from the front of the rear of the train, the front cars being quickly arrested and the rear cars running at full speed colliding with those in front before the brakes on said rear cars were brought fully into action. The defect in this particular was not due to the "triple valves," as these were adapted to quickly respond to a sudden reduction of pressure in the train-pipe, but the difficulty was in the way of producing the requisite degree of reduction simultaneously throughout the entire length of the train-pipe so that the several triple valves would be brought into action simultaneously.

Numerous schemes were devised for overcoming this defect in the old automatic air-brake system when applied to long trains, and some of them contemplated the opening of escape ports located at intervals in the length of the train-pipe, the operations necessary to open and close said serial vents being performed by the movement of the air in the train-pipe.

As illustrating one way by which the reduction of pressure throughout the length of the train-pipe is accelerated, I will refer to patent No. 217,838 granted to G. Westinghouse, Jr., July 22, 1879, wherein is shown and described what is termed an "automatic brake relief valve" adapted for insertion at various points in the length of the train-pipe, and to be operated by a reduction of train-pipe pressure, to open a vent or escape port. These relief valves are located at intervals in the train-pipe, preferably at the couplings between the cars, and they are caused to operate successively whenever the pressure is considerably reduced in the forward end of the train-pipe, that is to say, when the engineers' valve is operated to reduce the pressure in the train-pipe, the first relief valve is operated to open an escape port or vent, through which latter the air escapes from the following section of the train-pipe, and the reduction of pressure thus effected actuates the second relief valve to

cause the depletion of the train-pipe air in the next section, and so on throughout the length of the train. By this means a series of discharges of train-pipe air was effected instead of a single discharge through the engineers' valve, and instead of requiring that the air should flow from the extreme rear end of the air pipe to the engineers' valve, numerous vents were provided for the escape of train-pipe air. In other words, each relief valve discharged train-pipe air from its particular section, thereby not only causing the actuation of the triple valve, but also the next succeeding relief valve.

This illustrates the most advanced stage in "quick action" as applied to the old automatic air-brake system, involving the triple valve, with which I am acquainted.

There were other forms of quick-action brake appliances in which air was employed as a motive power, and supplied to auxiliary reservoirs through a train-pipe, but instead of the triple valve operated by variations of pressure in the train-pipe to apply and release the brakes, electrically operated valves were employed, electricity being used for effecting a simultaneous action of all the brakes.

Adjourned at 4 p. m., to meet at same place on Monday, May 15th, 1893, at 10.30 a. m.

10.30 A. M., MAY 15TH, 1893.

Met pursuant to adjournment.

Q. 8. Explain the construction and operation of the mechanical device or combination constituting the "quick-action" device, described and shown in the patent No. 360,070, here in suit, and specified in the 1st, 2nd and 4th claims thereof.

A. The alleged invention of the patent referred to is denominated an improvement in "fluid-pressure automatic brake mechanism," and is designed to produce a serial quick action of the triple valve and of the brakes by a discharge of air from or venting of
969 the train-pipe at different points in the length of the latter, thereby hastening the reduction of pressure in the train-pipe, and in addition thereto utilizing the air whose discharge effects a reduction in the pressure of train-pipe air by conducting it into the several brake-cylinders, instead of discharging it into the atmosphere.

As a whole, the automatic brake mechanism of this patent is identical with that previously in use and described in patent No. 220,556, with one slight modification in one of the parts of the "triple valve," and the addition of an auxiliary-valve device, through the medium of which latter the air is discharged from the train-pipe directly into the brake-cylinder and independently of the triple valve proper, to effect the result termed "quick action."

The auxiliary-valve device is arranged to be operated by the piston of the triple valve proper as previously used. Before explaining the additional members constituting this auxiliary-valve device, I will briefly explain the automatic air-brake system in use prior to said patent No. 360,070, and with which the new device of said patent is combined.

As before stated, the automatic air-brake equipment is the same as, and includes, the triple valve of patent No. 220,556; that is to say, it includes an air compressor, main air reservoir and engineers' valve located upon the engine; a train-pipe in sections, each car being provided with a section; an auxiliary reservoir under each car; a brake-cylinder and brake-actuating devices under each car, and the triple valve of patent No. 220,556 controlling the passage from the train-pipe to the auxiliary reservoir, the passages through which auxiliary reservoir air is conducted to the brake-cylinder (said passages including the graduating passage in the main valve, as well as the passage controlled by the main valve alone,) and the exhaust passage from the brake-cylinder to the atmosphere.

11.15 a. m.—Mr. George H. Howard at this point appeared for complainants.

970 When the cars, separately equipped as described, are connected together to form a train, the train-pipe sections are coupled together to form a continuous conduit extending the full length of the train, the rear end of said train-pipe being closed by a valve and the front end connected with the engineers' valve.

In the absence of the new elements and functions added to the

triple valve, the operation of the entire equipment described in this patent would be the same as that of patent No. 220,556; that is to say, a slight reduction of pressure in the train-pipe would cause the piston of the triple valve to move towards the train-pipe side, closing the feeding passage leading to the auxiliary reservoir, and actuating the main and auxiliary valves to close the exhaust passage leading from the brake-cylinder to the atmosphere, and bring the graduating passage 31 wholly or partially in register with passage 23, leading to the brake-cylinder.

Under the conditions named the movement of the valve piston would be arrested by its contact with the graduating stem 36, and the flow of auxiliary reservoir air through the graduating passage would be interrupted when the pressure on auxiliary reservoir side of the piston was diminished below that on the train-pipe side by the slight movement of the piston closing valve 29 against its seat, said valve 29 being the "auxiliary valve" of patent No. 220,556 and the "graduating valve" of patent 360,070. To increase the pressure in brake-cylinder graduating operations are repeated; and to release the brakes the pressure in train pipe is restored.

When, however, the pressure in train-pipe was suddenly and considerably reduced, either by the engineer or automatically, by the breaking of the train or the bursting of the train-pipe, the preponderance of auxiliary reservoir air pressure upon the piston of the triple valve would carry said piston, and the valve connected thereto, its full stroke, and in so doing would drive back the graduating stem and carry the graduating port 31 in main valve beyond the port or passage 23, through which latter communication was before 971 made with the brake-cylinder, thereby opening communication between the auxiliary reservoir and brake-cylinder through a passage 35 in the end of the main valve, one end of said passage opening into the valve chamber and being always in communication with the auxiliary reservoir, while the other end terminates at the face of the valve and registers with the port 23 when the valve piston is fully retracted.

The slight modification which I have mentioned as having been made in the triple valve of patent 220,556, consists in the elongation of the main valve and the introduction of the supply passage 35 through which air is conducted directly from the auxiliary reservoir to the brake-cylinder.

In patent 220,556 the main valve (lettered H in said patent) was of such length as to uncover the mouth of passage C when the valve piston made its full stroke toward the train-pipe side, while in the modified form shown in patent 360,070, substantially the same operation is performed by the end of passage 35 registering with port 23, the only difference being that in the one case auxiliary reservoir air is caused to flow past the end of the main valve into port 23, while in the other it passes through an opening or passage 35 in the end of the main valve and thence through port 23.

My conclusions concerning the construction and operation of the entire automatic air-brake system of this patent, excluding the new parts, is not alone based upon a comparison of the triple valve with

the prior triple valve of patent No. 220,556, but is in part derived from the direct admissions made by the patentee in his specification. Thus I find the following statement on page 2 of the specifications, lines 29 to 46, inclusive:

"So far as the performance of its preliminary function in ordinary braking is concerned—that is to say, effecting the closure of communication between the main air pipe and the auxiliary reservoir and the opening of communication between the auxiliary reservoir and the brake-cylinder in applying the brakes, and the reverse operation in releasing the brakes—the triple valve 10 accords substantially with that set forth in letters patent of the United States No. 220,556, granted and issued to me October 14, 1879, and is not, therefore, saving as to the structural features by which it performs the further function of effecting the direct admission of air from the main air pipe to the brake-cylinder, as presently to be described, claimed as of my present invention."

Referring to the "triple valve proper" and its construction, it is said, page 2, lines 60 to 69, inclusive:

"The triple-valve case is fitted with a cylindrical sleeve or bushing 11, which is bored out truly and forms the chamber of a piston 12, which is fixed upon a stem, 13, carrying, as in my letters patent No. 220,556, before mentioned, a slide-valve, 14, which controls communication between the auxiliary reservoir and the brake-cylinder and between the brake-cylinder and release port 15, respectively."

In the description of the modification to which I have referred, no mention whatever is made of any new or additional functions performed by the passage 35, said passage serving only to establish direct communication between the auxiliary reservoir and brake-cylinder, as was previously done by the end of the main valve. The description of this passage 35 is found on page 3, lines 4 to 19, inclusive, as follows:

"The construction and relative arrangement of the piston stem 13 slide-valve 14 and graduating valve 29 are substantially similar to those of the corresponding parts as heretofore employed by me and exemplified in my letters patent No. 220,556; but under my present invention these are supplemented by a port, 35, leading from the end of the valve adjacent to the opening of the chamber 24, which communicates with the auxiliary reservoir, to the face of the valve, so as, at the limit of traverse of the piston stem in the application of the brakes, to establish communication directly through said passage between the auxiliary reservoir and the port 23 and passages 22 and 16, leading to the brake-cylinder."

I understand the *direct* communication which is described as being established through said passage 35, to be the same as the direct communication previously made by uncovering the port C of patent No. 220,556, and referred to on page 10 of complainant company's catalogue of 1886, where it says:

"As the piston descends, it moves with it the slide-valve 6 so as to

permit air to flow *directly* from the auxiliary reservoir into the brake-cylinder."

My conclusion that the introduction of the passage 35 was not intended to and does not change the operation of the device is further supported by the statement following the description of said modification on page 3, lines 39 to 43, as follows:

"So far as hereinbefore described, the triple valve accords in all substantial particulars with, and is adapted to operate similarly to those of letters patent Nos. 168,359, 172,064 and 220,556."

Recess.

I will now proceed to describe the new parts added to the old brake-equipment, and which constitute the only novel features of the brake mechanism described in patent 360,070, as is clearly set forth in the specification of the patent, wherein it is declared (page 3, lines 43 to 47) after stating that the triple valve itself and its mode of operation were the same as the prior patented structures, that

"In order that it may perform the further functions requisite in the practice of my present invention, it is provided with certain additional members, which will now be described."

The "additional members" to which reference is made in the above-quoted paragraph of the specifications, include a passage 974 extending from the train-pipe side of the triple-valve piston directly to the brake cylinder, said passage being entirely outside and independent of the triple valve proper, although formed in the same casing, a check-valve arranged in said passage and opening towards the brake-cylinder, and a slide-valve controlling the inlet end of said passage; that is to say, the end opening into the train-pipe end of the piston chamber, said slide-valve being connected to and operated by the graduating stem of the triple valve proper. The passage I have referred to as connecting the train-pipe side of the triple valve and the brake-cylinder is not shown in the patent as a straight passage, but is made up of the following parts: Its connection with the train-pipe begins at the port 42, it being understood that train-pipe air is delivered into the valve-piston chamber substantially as in prior patent 220,556. Port 42 communicates with the chamber 43 containing the check-valve 49, and from the rear of said check-valve extends the passage 46, opening into a chamber 47, and the latter communicating with the brake-cylinder through a pipe 48. These communicating passages are fully disclosed in "Defendants' Exhibit Section of Westinghouse Triple Valve of Patent 360,070 (red valve)."

I may here remark that the passage 22 of the triple valve proper through which auxiliary reservoir air is admitted to the brake-cylinder, opens into chamber 47, and that the pipe 48 forms the conduit through which air delivered from the auxiliary reservoir and from the train-pipe side of the valve piston passes to the brake-cylinder.

Considering the passage as one element, it will be seen that the "additional members" referred to in the specification of the patent, are three in number, to wit: the passage around the triple valve

proper, the check-valve 49, and the slide-valve 41, controlling port 42 at the beginning of said passage.

Now, the object and purpose had in view in the addition of these members to the old triple valve was twofold.

975 First. To provide a series of discharge openings through which train-pipe air could escape and thus more quickly effect a reduction of pressure in the train-pipe after the manner indicated in prior patent No. 217,838 of July 22, 1879; and

Secondly. Utilizing the air escaping from the train-pipe by conducting it into the brake-cylinder instead of discharging it into the atmosphere.

In so far as the first of these two actions is concerned, it would appear to be but an enlargement upon or extension of the operations performed by the device described in patent No. 217,838, July 22d, 1879, wherein it is stated with reference to the ordinary automatic brake system that

"It sometimes happens with such brake apparatus, especially in case of accident, that material advantage could be effected by having all the brakes of the train applied or brought into action simultaneously, or as nearly so as possible. To accomplish this it is only necessary to make provision for the simultaneous opening of one or more ports in the air-conduit passages at points not remote from each auxiliary reservoir."

Upon comparison, it will be found that substantially the same operation is designed to be performed by these "additional members" of patent 360,070, as appears from the following statement in the specification (page 1, line 73 to 90):

"The application of the brakes with their full force has heretofore required a discharge of air from the main pipe sufficient to reduce the pressure in said pipe below that remaining in the auxiliary reservoir after the brakes have been fully applied, and it has been found that, while the brakes are sufficiently quick in action on comparatively short trains, their action on long trains of from thirty to fifty cars, which are common in freight service under present practice, is in a measure slow, particularly by reason of the fact

976 that all the air required to be discharged from the main pipe to set the brakes must travel from the rear of the train to a single discharge opening on the engine. This discharge of air at the engine has not only involved a serious loss of time in braking, but also a waste of air."

Inasmuch as the automatic brake relief valve of patent 217,838 was designed to and did provide a series of escape ports through which air from the train-pipe could be permitted to escape, to hasten the reduction of pressure in said train-pipe, the statement quoted last above from patent 360,070 is not strictly accurate, if intended to convey the impression that the only known means for quickly reducing the pressure of air in the train-pipe was through the single discharge at the engineers' valve.

The addition of the new element to the triple valve of patent 220,556 did not in any way change or affect the operation of said triple valve, but merely added the functions pertaining to said

"additional members," that is to say: the triple valve proper performed its usual functions, both in applying graduated pressure and in opening direct communication between the auxiliary reservoir and the brake-cylinder, and the "additional members" were arranged to come into action during the last portion of the stroke of the valve piston with the following result.

So long as the valve piston is operated within the limit allowed for graduating, that is to say, until it makes contact with the graduating stem, the action of the triple valve is the same as that of patent 220,556, the valve 41 remaining over port 42, so that no air can enter the passage forming one of the "additional members."

When, however, the pressure in the train-pipe is suddenly reduced, and to a degree sufficient to cause the piston of the triple valve to retract the graduating stem and open direct communication between the auxiliary reservoir and the brake-cylinder, through passage 35

in main-valve 14, valve 41, connected to the graduating stem, 977 will be moved by the latter to uncover port 42, thus permitting train-pipe air to enter the passage, unseat the check-

valve and enter the brake-cylinder, thereby assisting in depleting the train-pipe, and utilizing the air thus withdrawn by causing it to act upon the piston in the brake-cylinder. As the parts are arranged and adjusted in the patent, the port 42 is opened by the movement of slide-valve 41 slightly in advance of the opening of port 23 by the movement of the main valve, to bring passage 35 in communication with said port 23, hence the air from train-pipe entering through port 42 flows into the brake-cylinder without encountering any resisting air pressure until after port 35 is brought to uncover port 23, when air from the auxiliary reservoir will also be conducted into the brake-cylinder as in the old triple valve of 1879. As soon as the pressure in the brake-cylinder and passage equals or exceeds the pressure in the train-pipe, which it soon does by reason of the flow of compressed air from the auxiliary reservoir into the brake-cylinder, check-valve 49 will be operated by its spring to close the passage between train-pipe and brake-cylinder, and thus prevent the escape into the train-pipe.

There being a triple valve provided with the "additional members" mentioned under each car, when the pressure in train-pipe is suddenly reduced in a moderate degree, that is to say, reduced below the point necessary for a graduated application of the brakes, and low enough to cause a full stroke of the triple-valve piston, but without entirely depleting the train-pipe, each valve 41 (termed "an auxiliary valve") will be operated to open an escape from the train-pipe, and thus relieve the pressure in the latter and hasten the action of the next succeeding triple valve.

The piston of the triple valve proper is utilized in this construction to mechanically effect the movement of the auxiliary valve 41 in opening the escape port from the train-pipe, and, as before explained, the air withdrawn from the train-pipe, instead of being discharged into the atmosphere and wasted, is conducted around 978 the triple valve and discharged into the brake-cylinder, where it is utilized to supplement the auxiliary reservoir air ad-

mitted through the triple valve proper, in effecting the application of the brakes.

4.35 p. m. adjourned to meet at same place at 10.30 a. m., May 16th, 1893.

10.30 A. M., MAY 16TH, 1893.

Met pursuant to adjournment.

Parties present as before.

I should have mentioned that the "additional members" of the patent are only brought into action in effecting an emergency stop, the latter corresponding to the emergency stop produced by the old triple valve of patent No. 220,556; and that the action in effecting such emergency stops is improved by the addition of the functions, incident to said additional members of effecting a more rapid depletion of the pressure in train-pipe, and the utilization of train-pipe air in the brake-cylinder, resulting in a more nearly simultaneous action of the several triple valves.

The fact that the "additional members" are not employed in making ordinary graduated, or service, stops is made clear by the following statements in the patent (page 3, lines 93 to 105):

"To apply the brakes in making ordinary stops, a portion of the air is discharged from the main air pipe by the engineers' valve, thereby correspondingly reducing the pressure in the main air pipe, whereupon the higher pressure in the auxiliary reservoir moves the piston 12 to the right, covering the feeding groove 51, and thus preventing the return of air from the auxiliary reservoir to the main air pipe, the movement of the piston continuing until arrested by the decrease of pressure in the auxiliary reservoir, or by the stem

36 and its spring 39."

979 Page 4, lines 6 to 13:

"The admission of air to the brake-cylinder through the passage 31, which is opened just before the piston stem comes in contact with the graduating stem, and which corresponds to the feed-passage heretofore employed, suffices for the ordinary requirements of braking in regular service."

The passage 31, referred to as the feed-passage, is what I have designated as the graduating passage controlled by the graduating valve.

That the "additional members" are only brought into action in effecting an emergency stop, and that they operate only to supplement the action of the main valve of the triple valve is indicated by the following passages in the specification (page 3, lines 47 to 57):

"For the purpose of effecting the admission of air directly from the main air pipe 2 to the brake-cylinder 7, when it is desired to apply the brakes with great rapidity and full force, an auxiliary slide-valve, 41, is connected to and moves with the stem 36, said valve working over a face in the bushing 37 between the piston chamber 11 and drain-cup 19, and governing a port, 42, in said face leading into a chamber, 43, adjoining the same."

Page 4, lines 13 to 32:

"In the event, however, of its becoming necessary to apply the

brakes with great rapidity and with their greatest available force, the engineer, by means of the valve at his command, instantly discharges sufficient air from the front end of the main air pipe to effect a sudden reduction of pressure of about twenty pounds per square inch therein, whereupon the piston 12 of the triple valve is forced to the extreme limit of its stroke in the direction of the drain-cup 19, carrying with it the stem 36 and auxiliary slide-valve 41, which instantly uncovers the port 42 and discharges air from the main air pipe through the opening of the check-valve 49 and the passages 46 and 48 to the brake-cylinder, and, each car being provided 980 with one of these devices, it will be seen that they are successively moved with great rapidity," etc.

Page 4, lines 43 to 51 :

"When the piston 12 arrives at the extremity of its stroke, as above specified, the supplemental port 35 of the slide-valve 14 is brought into communication with the port 33 and passages 22 and 16, which serves to discharge the reservoir pressure into the brake-cylinder, thereby augmenting the pressure already exerted in the brake-cylinder by the air admitted from the main air pipe."

The statement last above quoted would indicate that a train-pipe air was admitted to the brake-cylinder sufficiently in advance of the admission of auxiliary reservoir air through passage 35, to produce the maximum pressure of admitted train-pipe air in the brake-cylinder before auxiliary reservoir air was delivered into the brake-cylinder, but in my opinion this is not strictly true. The auxiliary valve 41 is arranged to uncover port 42 and admit train-pipe air to the brake-cylinder, through the passage around the triple valve, slightly in advance of the admission of auxiliary reservoir air through the passage 35; and the passages and ports through which train-pipe air is conducted are relatively larger than those through which auxiliary reservoir air is conducted to the brake-cylinder; consequently the flow of train-pipe air to the brake-cylinder would precede auxiliary reservoir air, and a relatively larger volume would pass in a given time; but under the conditions of actual practice, the piston of the triple valve will move so rapidly that both passages, from train-pipe and auxiliary reservoir, will be opened instantly, and the flow of air will begin from the train-pipe only a small fraction of a second in advance of the auxiliary reservoir air.

I observe that in the drawings of patent 360,070 the passage 35 is represented as smaller in cross-section than the graduating passage 31 and the port 23 and passage 22 leading to the brake- 981 cylinder. No mention is made in the specification of this fact, nor is any function attributed thereto; on the contrary, the specification conveys an implication that the passage 35 performs the same functions as were performed by the end of the main valve of patent 220,556, in stating that the triple valve, of which passage 35 is a part, "accords in all substantial particulars with and is adapted to operate similarly to those of my letters patent Nos. 168,359, 172,064, and 220,556." In my opinion, however, if the port or passage 35 is made smaller than the port 23, as shown in the patent, it will operate to check the flow of auxiliary reservoir air into the

brake-cylinder, and thus permit a larger volume of train-pipe air to enter the brake-cylinder before it is checked by the expansion of the higher pressure auxiliary reservoir air.

I also observe that the feed-passage 31 of the graduating valve is smaller than port 23 (as is the case in patent No. 220,556), the reason for which is thus stated on page 4, lines 58 to 67:

"The feed-opening for the admission of air from the auxiliary reservoir to the brake-cylinder is purposely made of comparatively small diameter, it having been determined by experiment that the initial application of the brakes should not be made with maximum force, and this opening may be made of such size as to apply the brakes exactly in accord with the requirements of most efficient work."

I observe that throughout the specification of patent 360,070, the term "triple valve" is loosely and ambiguously employed, it being used to designate, first, the triple valve as previously known in the art and illustrated in prior patents, and, secondly, to designate the new device of the patent, including the triple valve of patent No. 220,556 as improved by the introduction of the "additional members," to wit, the passage, the check-valve, and the auxiliary valve.

As I have before explained, the term "triple valve" was in common use prior to the date of patent No. 360,070, and the valve
982 mechanism most popularly known under that title was of the form shown in patent No. 220,556. The "triple valve" of patent No. 220,556 is illustrated and described as such in patent 360,070 and is the triple valve said to be

"provided with certain additional members,"

in order that it may

"perform the further functions requisite in the practice of my present invention."

As illustrating the common use of the term "triple valve," as applied to the valve mechanism of patent No. 220,556, I refer to complainant company's catalogue of 1886 and complainant company's "Instruction Book" of 1886, and to the following patents granted to G. Westinghouse, Jr.:

No. 243,415, dated June 28, 1881, and

No. 235,922, dated December 28, 1880, and the patent to S. R. Kneeland,

No. 351,382, dated October 26, 1886.

I understand it to be in this sense, and as applying to other forms of triple valves proper (of which patents Nos. 168,369 and 172,064 are examples, although others exist,) that the following language is used in the patent under consideration (page 4, lines 68 to 85):

"In using the terms 'triple valve' and 'triple-valve device' I refer to a valve device, however specifically constructed, having a connection with the main air or brake pipe, another with an auxiliary reservoir or chamber for the storage of power, and another with a brake-cylinder, or its equivalent, for the utilization of the stored power and with a release or discharge passage for releasing the op-

erative power from the brake-cylinder, whether the valves governing these passages or connections are arranged in one or more cases and are moved by a piston, or its equivalent, or by a series of pistons or their equivalents, there being numerous examples in the art of constructions varying materially in appearance whereby these functions are performed, both in plenum and vacuum brake mechanisms."

983 I understand the term "triple valve" to be used with the second meaning, *i. e.*, triple valve proper *plus additional members*, in the following paragraph (page 1, lines 20 to 27).

"To this end my invention, generally stated, consists in a novel combination of a brake-pipe, an auxiliary reservoir, a brake-cylinder and a 'triple-valve' device, governing, primarily, communication between the auxiliary reservoir and the brake-cylinder; and secondarily, communication directly from the brake-pipe to the brake-cylinder."

The same meaning is given to the term in the paragraph beginning line 29, page 2, wherein it states that in performing its ordinary functions—

"*The triple valve* 10 accords substantially with that set forth in letters patent of the United States, No. 220,556, granted and issued to me October 14, 1879, and is not, therefore, saving as to the structural features by which *it* performs the further function of effecting the direct admission of air from the main air pipe to the brake-cylinder, as presently to be described, claimed as of my present invention. Certain of *its* elements devised and employed by me prior thereto, will, however, be herein specified in order to render *its* construction and operative relation to other members of the brake mechanism fully intelligible."

To briefly summarize the alleged novel elements and functions of the fluid pressure automatic brake mechanism of patent 360,070, as I understand them, they comprise the passage extending from train-pipe side of valve piston to brake-cylinder, the check-valve located in said passage and the auxiliary valve 41 controlling the admission of air to the aforesaid passage, these three elements constituting the so-called "additional members." The confessedly old devices are the entire brake-equipment, including train-pipe, auxiliary reservoir, brake-cylinder and a triple valve of the kind previously known under that name and particularly exemplified as of the form shown in patent No. 220,556.

984 As to functions, those of the ordinary triple valve are preserved without material change; that is to say, the triple valve is provided with a graduating valve, through which auxiliary reservoir air is admitted to the brake-cylinder in making graduated applications of the brake, and a second, or main valve, through the medium of which auxiliary reservoir air is admitted to the brake-cylinder when the valve piston is fully retracted, as when making an emergency or an automatic application of the brakes.

The functions of the "additional members" are, to open a port or passage communicating with the train-pipe on the train-pipe side of the triple valve proper, and thereby permit train-pipe air to escape

and thus reduce the pressure in the train-pipe, the air, as it escapes, being conducted around the triple valve proper and discharged into the brake-cylinder, where it is utilized to supplement or assist the air delivered from the auxiliary reservoir, through the triple valve proper, in effecting a full application of the brakes. The auxiliary valve of the additional members is caused to perform its office of opening the direct passage for train-pipe air to the brake-cylinder by its attachment to the graduating stem, which latter is actuated by the valve piston only when the preponderance of pressure on the auxiliary reservoir side is sufficient to overbalance the pressure exerted on the train-pipe side of the piston.

Recess.

The piston of the triple valve proper may be said to have, or be permitted, two degrees of motion within its cylinder, the one shorter than the other and limited, on the train-pipe side, by contact of the piston stem with the graduating stem; and the other a longer movement, including the first, and representing the maximum or full stroke of the piston, during which the graduating stem is retracted or pushed back by the piston.

During the first or preliminary movement of the piston the valve mechanism of the triple valve is operated to effect what has been explained as a graduating or service stop, and when so operating the auxiliary valve of the "additional members" is not moved to uncover the port 42, hence there is no discharge of train-pipe air into the brake-cylinder.

It is only during the last portion of the full stroke of the piston, when it opens the direct passage through port 35, that the direct passage from train-pipe to brake-cylinder is opened, and air permitted to pass to the brake-cylinder.

The question to which the foregoing is an answer, and the answer also, are objected to by counsel for complainants; the former as calling for, and the latter as assuming to give an explanation of construction and operation fully disclosed by patent No. 360,070, and a definition of the legal scope of the patent. The question and answer are objected to as incompetent, irrelevant and immaterial.

Q. 9. State what you understand to be claimed as new inventions in said 1st, 2nd and 4th claims, respectively, giving your reasons with your opinions.

Objected to as calling for an opinion in law, and as incompetent.

A. The first claim of the patent is as follows:

"1. In a brake-mechanism the combination of a main air pipe, an auxiliary reservoir, a brake-cylinder, a triple valve and an auxiliary-valve device, actuated by the piston of the triple valve and independent of the main valve thereof, for admitting air in the application of the brake directly from the main air pipe to the brake-cylinder, substantially as set forth."

I understand this claim to include the combination of the following parts or elements:

1. A main air pipe, which I have termed the train-pipe, for conveying air under pressure from a main reservoir or source of air supply on the engine to the point or points where it is to be utilized.

986 2. Means for maintaining and varying the air pressure in said main air or train pipe.

3. An auxiliary reservoir in which air is stored for subsequent use in braking.

4. A brake-cylinder with devices for actuating the brakes connected therewith.

5. A triple valve proper provided with a piston and valves controlling the admission of air from the main air or train pipe to the auxiliary reservoir, the escape of air from the brake-cylinder to the atmosphere and the admission of air from auxiliary reservoir to brake-cylinder, said triple valve being actuated by variations of pressure in the main air or train pipe.

6. An auxiliary-valve device, that is, an additional valve device auxiliary to the triple valve proper and independent of the main valve thereof; said auxiliary valve being actuated by the piston of the triple valve proper and operating to control a passage or passages connecting the train or main air pipe and the brake-cylinder in a manner to effect the admission of train-pipe air directly into the brake-cylinder, and without passing through the triple valve proper, the train-pipe air thus admitted being utilized in conjunction with the air delivered from the auxiliary reservoir through the triple valve proper, in effecting the application of the brakes quickly and with full power, and the withdrawal of air from the train-pipe serving to reduce the pressure in the latter and thereby quicken the movement of the triple-valve device on the next succeeding car.

Of the six enumerated elements, the first five are admittedly old; hence I understand the invention expressed in this claim is the combination with said old elements of the so-called "auxiliary-valve device," which latter is further described as *independent* of the main valve of the triple valve proper, and arranged to be actuated by the piston of the latter. The only device answering to

the description of "an auxiliary-valve device," as employed

987 in this claim, is the valve 41, which latter is described in

the specification as "an auxiliary slide-valve," and is one of the three additional members by which the invention of patent 360,970 is distinguished from the triple valve of patent 220,556, as previously employed. I understand further that the "triple valve" of this claim to which the "auxiliary-valve device" is added, may be either the triple valve shown and described in the patent, or other equivalent forms of triple valve, such triple valves performing their usual functions, that is to say, being operated to control the admission of train-pipe air to the auxiliary reservoir; to control the admission of auxiliary reservoir air to the brake-cylinder, *both* for graduating and full-pressure applications of the brake; and to control the escape of air from the brake-cylinder to the atmosphere.

Inasmuch as the auxiliary slide-valve 41 alone would be incom-

petent to effect the admission of air from the train or main air pipe to the brake cylinder, I understand the term "auxiliary-valve device" to include both the auxiliary slide-valve 41 and the passage extending from the train-pipe side of the triple valve to the brake-cylinder, said passage being another of the so-called additional members.

The second claim of the patent is as follows:

"2. In a brake mechanism the combination of a main air pipe, an auxiliary reservoir, a brake-cylinder, and a triple valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake-cylinder, and which by a further traverse admits air directly from the main air pipe to the brake-cylinder, substantially as set forth."

I understand this claim to include the first four enumerated elements of the first claim, and, in addition thereto, a fifth element, as follows:

5. A triple valve proper adapted to perform the ordinary functions of such a valve in effecting the admission of auxiliary reservoir air to the brake-cylinder when making a partial stroke, as in 988 graduating, and effecting a second admission of auxiliary reservoir air to the brake-cylinder by the further movement or completion of the full stroke of the valve piston, and valve device, supplemental or auxiliary to the main valve of the triple valve proper in effecting the admission of air to the brake-cylinder, said auxiliary-valve device being actuated by the piston of the triple valve proper during its final movement, and serving to open a passage from the train-pipe to the brake-cylinder.

In thus construing the claim as containing a fifth element composed of two parts, that is to say, a triple valve proper, and an auxiliary-valve device, I have not overlooked the fact that in the claim the fifth element is described as a triple valve possessing the capacity of admitting air directly from the train-pipe to the brake-cylinder; but, as I have before explained, the term "triple valve" is employed in the specification, to which the claim refers by the words "substantially as set forth," to define two structures, the one a triple valve proper, and the other the triple valve *plus* the additional members of the present patent, namely, the passage, the check-valve and the auxiliary valve; and inasmuch as the functions attributed to the triple valve of claim 2 are *not* the functions of the *ordinary* triple valve, but are those of the new valve mechanism, I have concluded that the second of the two definitions employed in the specification is the one implied in the claim.

If the term "triple valve" as employed in claim 2 means the triple valve of patent No. 220,556, (which is the triple valve proper of patent 360,070,) the combination expressed would be identical with the combination *disclaimed* in patent 360,070 and disclosed in patent No. 220,556; and said combination would be inoperative to effect the admission of air directly from the main air pipe to the brake-cylinder, inasmuch as that function is alone performed by the 989 "additional members" which are combined with the triple valve proper, and there is neither hint, suggestion nor

description in the patent of a triple valve proper by means of which, and without the addition of the auxiliary valve, train-pipe air could or would be admitted directly from the train-pipe to the brake-cylinder.

4.45 o'clock p. m., adjourned to meet at same place, Wednesday, May 17th, 1893, at 10.30 o'clock a. m.

10.30 A. M., MAY 17TH, 1893.

Met pursuant to adjournment.

Parties present as before.

In addition to the recitation of function contained in claim 2, indicating clearly that the "triple valve" of said claim is one competent to effect the direct admission of train-pipe air to the brake-cylinder, the fact, disclosed by the specification, that the invention of the patent consists in certain *additions* to the triple valve proper, by which certain functions are added, would naturally lead to the conclusion that the element designated in said claim as "a triple valve" was the triple valve proper of the patent when provided with the additional elements or members by which the further function of admitting train-pipe air directly to the brake-cylinder is performed.

The preliminary traverse of the piston mentioned in the claim I understand to be the movement, less than the full stroke, employed in making graduated or service stops; and the further traverse, to be the movement of the piston beyond the graduating position in making a full stroke—both of said motions being common to the ordinary triple valve proper, and neither being operative, in the triple valve proper, to effect the admission of air directly from the train-pipe to the brake-cylinder.

For the reasons stated above, I have concluded that the fifth element of the combination described in claim 2 is the new or
990 improved triple valve, composed of the old triple valve provided with the "additional members" by which it performs the further or added function of admitting air directly from the train-pipe to the brake-cylinder.

Claim 4 reads as follows:

"4. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere, respectively, and an auxiliary valve actuated by the piston stem and controlling communication between passages leading to connections with a main air pipe and with the brake-cylinder, respectively, substantially as set forth."

I understand this claim to include the combination of certain enumerated elements which go to make up an improved form of triple valve, differing from the prior triple valves by the inclusion of an element or elements not found in said prior triple valves, and described in the patent as "an auxiliary valve," co-operating with



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a passage or passages through which train-pipe air is conducted to the brake-cylinder. The enumerated elements are:

1. A case or chest for the reception and accommodation of the working parts and the various passages through which air is conducted.

2. A piston fixed upon a stem and working within a chamber or cylinder formed in the case.

3. A valve or valves moving with the piston stem and governing ports and passages leading to connections with an auxiliary reservoir and a brake-cylinder, for effecting the admission of auxiliary reservoir air to the brake-cylinder in applying the brakes, and between the brake-cylinder and atmosphere for exhausting the former in releasing the brakes.

991 4. An auxiliary valve arranged to be actuated by the stem of the piston which controls the movement of the valve or valves for effecting the admission of auxiliary reservoir air to the brake-cylinder.

5. Passages in the case connecting with the train-pipe on the one side and the brake-cylinder on the other, said passages being controlled by the auxiliary valve.

The first three enumerated elements I understand belong to the triple valve proper, while the fourth and fifth elements constitute two of the three "additional members," by which the new or improved triple-valve device of the patent is distinguished from previous forms of the triple valve proper.

The auxiliary valve of this claim is, as I understand it, the "auxiliary slide-valve 41" of the specification, and the passages between which it exercises control are the passages leading up from the train-pipe to the port 42 on the one side, and from the port 42 to the brake-cylinder on the other.

I understand that the "auxiliary valve" is *auxiliary* or supplemental to the triple valve proper, and that its function is to open and close communication between the train-pipe and brake-cylinder, the movement of said auxiliary valve in opening communication between the train-pipe and brake-cylinder being effected, during the latter portion of the stroke of triple-valve piston, through a connection or contact with the latter.

I have not overlooked the fact that the combination of this claim is stated to be "in a triple-valve device;" but I understand this expression to be employed as descriptive of the new structure, including both a triple valve proper and the new or additional members.

In construing the foregoing claims, I have considered and regarded the auxiliary valve 41 of the patent as a material and essential element without which the several combinations recited would be inoperative to effect the desired results, and my reasons are briefly as follows:

First. Because but one embodiment of the alleged invention of the patent is shown or described therein;

992 *Second.* Because the auxiliary valve, the passage controlled thereby through which train-pipe air is conducted directly

into the brake-cylinder, and a check-valve located in said passage constitute the additional member or elements by which the alleged invention is distinguished from the prior art, and the triple-valve device of the patent is distinguished from the prior triple valve of the 1879 patent (220,556); and

Third. Because the auxiliary valve, as such, is specifically named in claims 1 and 4, and is necessarily implied in claim 2 for the reasons I have heretofore stated.

The answer is objected to as a purely legal opinion upon the scope of the claims enquired about and as therefore incompetent.

Recess.

Q. 10. Describe the construction and operation of the defendants' brake apparatus which is alleged by the complainants to be an infringement of said 1st, 2d, and 4th claims of patent No. 360,070.

A. As I understand the matter, the defendants' brake apparatus, which is alleged to infringe patent No. 360,070, is of two kinds, that is to say, includes the use of two forms of quick-action triple valve, the one represented in plate IX of defendants' 1889 catalogue, and the other represented in plate XI of defendants' 1891 catalogue, and Defendants' Exhibit Drawing of Triple Valve of Plate XI, Defendants' 1891 Catalogue. Each of the quick-action triple valves referred to is employed as part of an automatic air-brake system containing—

1. An air compressor or source of air supply, usually located upon the engine, and including an air pump and main air reservoir.

2. A train-pipe.

3. An engineers' valve for opening and closing communication between the main air reservoir and train-pipe, and between the latter and the atmosphere.

4. An auxiliary reservoir under each car.

5. A brake-cylinder under each car, and

6. The quick-action triple valve substituted for the ordinary triple valve.

The only substantial difference between the complainants' automatic air-brake equipment and that employed by the defendants is in the triple-valve mechanism.

I will first describe defendants' quick-action triple valve as exhibited in plate XI of defendants' 1889 catalogue, using the numerals and letters of reference appearing therein.

It consists of a valve casing 1, 2, provided with a piston chamber *c*, one end of which is in communication with the train-pipe through the coupling 22, the other end of said piston chamber communicating with the auxiliary reservoir through a passage *b*. The valve piston 5 is provided with a hollow stem, the latter fitting a collar or thimble in the auxiliary reservoir end of the piston chamber. A valve chamber *d* is formed above the piston chamber, and said two chambers are in open communication through a small passage *e*, formed in the partition separating the valve chamber *d* from the piston chamber *c*. Above the valve chamber *d* is formed a chamber *g*, one end of which communicates with or opens into the brake-

cylinder, while the other end of said chamber *g* communicates through main port 16 with the upper end of the valve chamber. The check-valve 11 covers the upper end of the hollow piston stem and is held to its seat thereon by a spring 12. The upper end of the piston stem is provided with a piston valve 15, adapted to move in and out of the port 16 and thus open and close the passage through said port connecting the chamber *g* and the valve chamber *d*. In the upper end of the piston stem is formed a longitudinal passage, opening at one end into the valve chamber *d* and at the other into chamber *g*, and in said passage is arranged a
 994 graduating valve 13, the lower end of said valve co-operating with a valve seat in the piston stem for opening and closing communication between the brake-cylinder and valve chamber, *d*, through the piston stem. Above the chamber *g* is arranged the release valve 18, said valve being provided with a stem 17 projecting downward and engaging the upper end of the graduating valve 13.

The release valve 18 is located in a chamber 20, which is in open communication with the brake-cylinder through the passage, *a*, and connects, through passages 19 controlled by release valve 18, with the passage, *f*, opening into the atmosphere. Although the drawing does not very satisfactorily disclose the fact, I understand that in the actual construction of the device, the passage *e*, connecting the piston chamber and the valve chamber is relatively smaller in cross-section than the passage *b*, connecting the auxiliary reservoir and the piston chamber, or, rather, two or more passages *e* are employed, the aggregate transverse area of said passages being less than the cross-section of passage *b*, and further, that the area of the graduating port controlled by graduating valve 13 is less than that of the passage or passages *e*. The passage through the valve stem controlled by the check-valve 11 is much larger than the passage or passages *e*.

Omitting from consideration the relative proportions of the several passages, and the separation of the valve chamber *d* from the auxiliary reservoir end of the piston chamber, and assuming that a free and full communication is provided between the auxiliary reservoir and valve chamber, so that the pressure of air in said valve chamber would at all times equal that in the auxiliary reservoir, the device as a whole would constitute an ordinary triple valve, possessing only the functions of a triple valve, such as that described in patent No. 220,556, that is to say: it would exhibit a feeding valve through which air from the train-pipe would be admitted to the auxiliary reservoir; an exhaust valve through which air from the brake-cylinder would be discharged
 995 to the atmosphere; a main valve operating to fully uncover the passage between auxiliary reservoir and brake-cylinder, as in making an emergency or full stop; and a graduating valve through which air from the auxiliary reservoir would be admitted to the brake-cylinder intermittently, in limited quantities, as in making graduated applications of the brakes. When thus operating as a triple valve proper to charge the auxiliary

reservoir, the maximum pressure of air in the train-pipe would be established, forcing the piston towards the auxiliary reservoir side, thereby inserting main valve 15 in the port 16, and causing the graduating valve to engage the stem 17 of release valve and raise the latter, at the same time seating the graduating valve. As a result of this movement of the piston, the release port would be opened, and communication between the brake-cylinder and auxiliary reservoir through the graduating and main valves closed. The pressure of train-pipe air under check-valve 11 will unseat the latter and flow through the passages leading to the auxiliary reservoir, thus charging the latter.

The auxiliary reservoir having been charged, if the pressure in the train-pipe is reduced slightly, say from five to eight pounds, the piston will be moved, by the preponderating pressure of auxiliary reservoir air, to first seat the release valve 18, and then, by withdrawing the graduating valve 13 from contact with the release-valve stem 17 (which latter previously held the graduating valve to its seat), said graduating valve will be free to rise under the influence of auxiliary air, thus opening the graduating passage and permitting the air to flow into the brake-cylinder. During the performance of this operation the main valve 15 is not withdrawn from the port 16, and as soon as the pressure of auxiliary reservoir air is reduced, by expansion into the brake-cylinder, below the pressure of air in train-pipe, the piston will be moved towards the auxiliary reservoir end of the piston chamber until the graduating valve 13 engages the release-valve stem 17 and become seated, thereby arresting the flow of auxiliary reservoir air into the brake-cylinder. To increase 996 the pressure in the brake-cylinder, a further slight reduction of pressure in the train-pipe will be made as before. During this operation of graduating the release valve 18 remains seated.

To apply the brakes with full power in the shortest possible time, as in making an emergency stop, or in automatically applying the brakes, the pressure of air on the train-pipe side of the piston is suddenly or entirely reduced, and the piston under the influence of auxiliary reservoir pressure, will be caused to make its full stroke towards the train-pipe, thereby instantly withdrawing the piston valve 15 from the port 16 and opening a relatively large passage through which the air from auxiliary reservoir will flow to the brake-cylinder.

To release the brakes and recharge auxiliary reservoir, pressure in the train-pipe is restored, and the piston moved thereby to open release port, and close graduating and main valve ports, when the feeding will take place through the port controlled by the check-valve.

The operations described are generally the same as those performed by the "triple valve proper," and do not include the special function of a quick-action triple valve, as that term is used to indicate the depletion of the train-pipe and the delivery of the air from the train-pipe into the brake-cylinder.

The conversion of this triple valve proper, possessing the ordinary triple-valve functions, into a *quick-action* triple valve is most in-

geniously effected by the proper proportioning of the air ports or passages. By the interposition of the partition between the valve chamber *d*, and the piston chamber *c*, and the provision of a passage or passages *e*, less in cross-section than the passage *b*, communicating between auxiliary reservoir and piston chamber, it becomes possible to produce on occasion *differential pressures* in the piston chamber and the valve chamber, that is to say, the air in the piston chamber being at all times maintained at auxiliary reservoir pressure, and the air being compelled to traverse the restricted

997 passage *e*, before it enters the valve chamber, if the pressure in the latter is suddenly lowered to a considerable degree, as by expanding the air suddenly into the brake-cylinder, the quantity of air admitted through the restricted passage *e*, will be insufficient to at once raise the pressure in the valve chamber, *d*, to that in the auxiliary reservoir, and there will be a momentary but decided difference in the pressures, notwithstanding the fact that the discharge of air through passage *e* commences at once and is continuous until an equalization of pressure is produced.

Normally the pressure in the valve chamber *d* and the auxiliary reservoir end of piston chamber *c* are equal; but when the train-pipe pressure is suddenly reduced, say 15 to 20 pounds, and the piston is operated to withdraw the main valve 15 from its port or passage 16, thus permitting a full and free flow of air from the valve chamber *d* to the brake-cylinder, the pressure in valve chamber *d* will be instantly reduced (the flow of auxiliary reservoir air through the passage or passages *e* being retarded), and, falling below the retained pressure in train-pipe, the air from the latter will immediately unseat the check-valve 11, and, mingling with that issuing through the restricted passage or passages *e*, will flow through the port controlled by the main valve 15 and enter the brake-cylinder. The flow of air from the train-pipe continues until the pressure in the valve chamber *d* nearly equals that in the train-pipe, when the check-valve will close and the air from the auxiliary reservoir will continue to be discharged through the passage *e*, and main valve port 16 into the brake-cylinder.

The discharge of air into the brake-cylinder through the graduating valve, in making graduating applications of the brakes, does not effect an unseating of the check-valve and the admission of train-pipe air, because the capacity of the graduating valve to permit the passage of air is less than that of the opening or openings *e*, through which auxiliary reservoir air flows into the valve chamber,

hence the pressure in valve chamber *d*, will remain the same
998 as in the auxiliary reservoir and the auxiliary reservoir end of piston chamber. As the movement of the piston, to effect the opening of the graduating port, is due to the preponderance of auxiliary reservoir air pressure and the same preponderance of pressure is being exerted in the valve chamber *d*, it follows that the check-valve will be held to its seat and the ingress of train-pipe air prevented. It is only when the conditions are such that the pressure existing in the valve chamber *d*, momentarily falls below the pressure of air in the train-pipe, that air from the train-pipe can

raise the check-valve and enter the valve chamber, and this condition is established when the main valve 15 is quickly withdrawn from its port and a relatively large escape port opened, through which the air in valve chamber *d*, can expand rapidly into the brake-cylinder.

5 p. m., adjourned to meet at same place on Thursday, May 18th, at 10.30 o'clock a. m.

10 30 A. M., MAY 18TH, 1893.

Met pursuant to adjournment.

Parties present as before.

I will now explain the second form of defendants' quick-action triple valve (illustrated in the 1891 catalogue) by reference to "Defendants' Exhibit Drawing of Triple Valve of Plate XI, Defendants' 1891 Catalogue," and "Defendants' Exhibit Section of Defendants' Triple Valve, Plate XI, 1891, Catalogue."

This triple valve involves the same principle of operation as the 1889 triple valve, before described; and its quick-action function is due to the same ingenious proportioning of the ports and passages, and the interposition of a partition separating the auxiliary end of the piston chamber from the valve chamber, whereby the triple valve proper is rendered capable, under certain conditions, of effecting the admission of train-pipe air into the brake-cylinder, in conjunction with auxiliary reservoir air, to apply the brakes
999 with full power; the withdrawal of air from the train-pipe serving to deplete the latter, and at the same time augment the pressure in the brake-cylinder.

The ports and passages in the valve case are substantially the same, as are also the piston and the check-valve, but the form of the release valve, the graduating valve and the main valve, together with the ports controlled thereby, is changed, without, however, substantially changing or modifying the functions of these parts. In the exhibit drawing to which I have referred, the passage leading from auxiliary reservoir to piston chamber is marked A; the piston chamber D; the piston 29; the feed-passage through stem of piston F; the check-valve 26 controlling the feed-passage F; the valve chamber C; the partition 9 between valve chamber and piston chamber; the restricted passage B connecting valve chamber and piston chamber; the chamber or passage H leading from the main valve to the brake-cylinder; the exhaust passage G; the train-pipe connection I; and the main valve port or passage through bushing 10 connecting the valve chamber and the chamber H leading to brake-cylinder.

The piston valve, 15, of the 1889 triple valve is replaced by a poppet valve 22 through which the stem 18 of the piston 29 passes, said stem being provided with shoulders for engaging the main valve, to move the latter, and at the same time permit a limited movement of the piston independently of the main valve. The graduating valve is formed by a port 40, in valve stem 18; said port communicating with a small passage in the valve stem opening into chamber H. The port 40 alternately enters and is with-

drawn from the main valve 22, accordingly as the piston is moved toward the auxiliary reservoir side or the train-pipe side, and when said port 40 is carried within the main valve 22, the graduating passage is closed and when the port is withdrawn from within the main valve 22, as the piston moves towards the train-pipe side, communication is established between the valve chamber C 1000 and the brake-cylinder, through the passage in the valve stem and the chamber H.

The poppet valve 18 which controls the escape of air from the brake-cylinder to the atmosphere in the 1889 triple valve, is here replaced by a piston valve 17 attached to the end of the valve stem 18, and, working in a port or passage I, the latter connecting chamber H and the brake-cylinder with the exhaust passage G.

A spring 16 whose range of motion is limited, engages or is engaged by the end of piston stem 18.

In describing the operation I will first explain the movements of the several parts in effecting graduating applications of the brakes. The maximum or working pressure being established in the train-pipe, the piston 29 is forced towards the auxiliary reservoir end of its chamber until it arrives at the position represented in the drawing, whereupon main valve 22 is seated, and graduating valve port 40 is carried within said main valve, thereby closing communication between the valve chamber and the brake-cylinder; at the same time, the release valve 17 is moved from port I, compressing the spring 16, and opening communication from the brake-cylinder to the atmosphere through the chamber H, port I, and passage G. The check-valve 26 is raised from its seat by the pressure of train-pipe air, and the latter flows into valve chamber C, from whence it is conducted to the auxiliary reservoir, through the restricted passage B, piston chamber D and large passage A. As soon as the pressure is equalized, or nearly so, in auxiliary reservoir and train-pipe, check-valve 26 is seated by its spring, and the return of air to the train-pipe is prevented. If, now, the pressure in train-pipe is slightly reduced, so as to create a slight preponderance of pressure on the auxiliary reservoir side of the piston, the latter will be moved towards the train-pipe side, first closing the escape from the brake-cylinder, by causing the piston valve 17 to enter the port I, and next opening communication between the valve chamber C and the brake-cylinder, by the withdrawal of graduating port 40 from within the main valve 22, the latter being held 1001 to its seat by the pressure of air in valve chamber C. Under the conditions named, the piston continues its motion towards the train-pipe side until the shoulder on piston stem 18 engages main valve 22; and the reduction of pressure in train-pipe not being sufficient to overcome the resistance offered by main valve 22, the further movement of the piston is arrested and it remains stationary until the pressure on auxiliary reservoir side is so far diminished, by the escape of air through the graduating port and passage into the brake-cylinder, that the retained train-pipe pressure will gradually preponderate and move the piston towards the auxiliary reservoir, thereby carrying the graduating port 40 within the main

valve 22, and arresting the further flow of auxiliary reservoir air to the brake-cylinder, without, however, opening the release port 1. Owing to the fact that the graduating port is smaller and, hence, has a less capacity for the discharge of air than the passage B through which auxiliary reservoir air enters the valve chamber C, the pressure in said chamber C will remain the same as that in auxiliary reservoir, and the check-valve 26 will remain seated. To effect a further increase of pressure in the brake-cylinder, by graduation, the pressure in the train-pipe is again diminished slightly, and the operations described are repeated.

To release the brake and recharge the auxiliary reservoir, the pressure in train-pipe is restored, and the piston forced to the auxiliary reservoir end of the chamber, thereby opening the exhaust passage from the brake-cylinder, and also permitting air to enter through the check-valve port.

To make what is termed a "quick-action" or "emergency" application of the brakes, the pressure in the train-pipe is quickly and considerably reduced, say to the extent of 15 to 20 pounds. The auxiliary reservoir air being now under a pressure of from 15 to 20 pounds greater than that in the train-pipe, it instantly compels the piston to make a full stroke towards the train-pipe, unseating the main valve 22 so that the air in valve chamber C immediately rushes through the large port in bushing 10 into the brake-cylinder. The auxiliary reservoir air is retarded by the restricted passage B, and, notwithstanding the fact that it is under a much higher pressure than the train-pipe air, it cannot at once restore the pressure in valve chamber C; and the pressure of train-pipe air, being for the moment greater than the pressure in valve chamber C, raises the check valve 26 from its seat and train-pipe air flows through the feed-opening F into the valve chamber, where it joins the auxiliary reservoir air entering through the passage B and is conducted through the main valve port in bushing 10 into the brake-cylinder. The flow of train-pipe air through the feed-opening F ceases the moment the pressure in valve chamber C nearly equals that in the train-pipe, but this does not occur until a considerable volume of train-pipe air has passed through the large feed-passage F and large main valve port in bushing 10 into the brake-cylinder, where it serves to increase the braking power above that which would be exerted by the auxiliary reservoir air alone; and at the same time, by the withdrawal or escape of air from the train-pipe, the action of the brake mechanism on succeeding cars is quickened.

It will thus be seen that the quick-action principle involved in this structure rests entirely upon the establishment of *momentary differential pressures* on the auxiliary reservoir and train-pipe sides of the piston, and in the valve chamber C, into which latter both train-pipe air and auxiliary reservoir air are discharged at the same time, and from which they are conducted through the *same* main valve port to the brake-cylinders; and, further, that the pressures on train-pipe and auxiliary reservoir sides of the piston and in the valve chamber C being normally equal, (which is the condition

when the brakes are released and the train-pipe charged with air at maximum pressure) the differential conditions will then be established when the train-pipe pressure is suddenly and considerably lowered, the air in valve chamber C quickly discharged and the flow of auxiliary air into the valve chamber C retarded.

1003 Recess.

In describing the defendants' quick-action triple valve of the 1889 and 1891 catalogues, I have referred to the mechanism, (exclusive of the partition separating the valve chamber from the auxiliary reservoir end of the piston chamber in which the restricted passage *c* [or B] is formed,) as a triple valve proper, meaning thereby a valve mechanism having a connection with the train-pipe, another with the auxiliary reservoir, a third with the brake-cylinder and a fourth with the atmosphere; with valves controlling the feed-passage between train-pipe and auxiliary reservoir, between the brake-cylinder and atmosphere and between the auxiliary reservoir and brake cylinder—and my reasons for thus classifying defendants' triple valves are as follows:

The triple valve, as it was known prior to the year 1879, did not contain a separate "graduating valve," but relied upon the partial or intermittent opening of the main valve port for effecting graduating applications of the brake, by the admission of less than the full pressure of auxiliary air into the brake-cylinder; and provision was made whereby the main valve port would be widely opened or wholly uncovered for admitting auxiliary reservoir air directly into the brake-cylinder, to apply the brakes with full force and in the quickest possible time. Generally speaking, the means by which these operations and the operations of feeding the auxiliary reservoir and exhausting the brake-cylinder were performed was by a combination of parts corresponding substantially with the defendants' triple valve, omitting the "partition" and the graduating valve; the omission of the partition separating the valve chamber from the piston chamber and the restricted supply passage *c* (or B) being accompanied by the production and maintenance of full auxiliary reservoir pressure in the valve chamber. The forms of the
1004 valves employed varied greatly, as did their arrangement, but the general combination and mode of operation was the same as the defendants' valve mechanism.

As illustrating the prior art I will refer to the patents of Westinghouse, No. 141,685, of August 12, 1873, and No. 144,006, of October 28, 1873; Perkins, No. 163,242, of May 11, 1875; Jones, No. 166,386, of August 3, 1875; Perrine, No. 166,405, of August 3, 1875, and Westinghouse No. 172,064, of January 11, 1876. In each of the patents referred to is shown a triple valve containing the following elements—form disregarded—found in defendants' triple valves.

A valve casing; a piston chamber D (or *c*); a piston 29 (or 5), subjected on one side to auxiliary reservoir pressure and on the other to train-pipe pressure; a feeding-in valve 26 (or 11), through which train-pipe air is admitted to the auxiliary reservoir in charging the latter; a release valve 17 (or 18) for opening and closing

the exhaust from the brake-cylinder, and a main valve 22 (or 15), actuated by the piston and controlling a port or passage leading from the auxiliary reservoir into the brake-cylinder.

In some of these prior structures a main valve similar to the piston valve 15 of the 1889 catalogue was employed for controlling the flow of auxiliary reservoir air to the brake-cylinder, as illustrated, for example, in the Perkins patent No. 163,242, the Jones patent No. 166,386 and the Perrine patent No. 166,405; while in others the poppet form of main valve 22, shown in defendants' 1891 catalogue, was used, as illustrated, for example, in the Westinghouse patents Nos. 141,685 and 144,006. It was also common to employ a check-valve for the feeding-in valve, similar to the check-valve 26 (or 11), said check-valve being carried by the piston, as in defendants' valves; this feature is shown in the Westinghouse patent No. 144,006; Perkins No. 163,282, Jones No. 166,386 and Boyden No. 280,285.

In 1879 the graduating valve, as a separate feature of the triple valve, that is to say, performing a part of the functions of the main valve in effecting graduating applications of the brake, was introduced and became a part of the device known as a "triple valve," and by a comparison of defendants' triple valves with patent No. 220,556 of 1879, I find the functional equivalent of the graduating valve 40 (or 13) in the graduating valve *e'* of said patent.

Referring to said patent No. 220,556 of 1879, and comparing the same with defendants' triple valves, I find that they all possess substantially the same functions, are made up of equivalent parts that operate in substantially the same manner, omitting, of course, the quick-action function of defendants' valve and the means by which such action is produced. The piston G, working in piston chamber B of the patent, and subjected to auxiliary reservoir air on one side and train-pipe air on the other, is represented in defendants' triple valves by the piston 29 (or 5) and piston chamber D (or *c*); the feeding-in valve of the patent, represented by the port *a*, and the end of the graduating stem *b'* in figure 1, and by the piston and groove, *a*, in figure 4, corresponds generally with the feeding-in passage and check-valve 26 (or 11); the release valve, *s*, of the patent, through which air from the brake-cylinder is discharged into the atmosphere, corresponds functionally with the release valve 17 (or 18); the main valve H of the patent controlling the direct passage between valve chamber and brake-cylinder, and only operated to uncover the port leading to the brake-cylinder when the piston is actuated by the preponderance of auxiliary reservoir air pressure, and caused to make its full stroke, finds its functional equivalent in the main valve 22 (or 15) of defendants' triple valves; and the graduating valve *e'* of the patent, and the graduating passage controlled thereby, are functionally represented by the stem 18, with its graduating port 40, and graduating passage in defendants' 1891 triple valve and by the graduating valve 13, with its port and passage of defendants' 1889 triple valve.

Upon comparing the operations performed by the triple valve of

said patent No. 220,556, with the operations performed by
 1006 defendants' valves, and omitting the quick-action of the latter,

I find them to be substantially identical, that is to say, upon maximum pressure being established in train-pipe, the pistons will be forced towards the auxiliary reservoir ends of their respective piston chambers and train-pipe air will be admitted through the feeding-in valves to charge the respective auxiliary reservoirs. Each piston moves its release valve to uncover the escape or exhaust port from the brake-cylinder during the last portion of the stroke when moving to the feeding-in position. To apply the brakes with less than the maximum power of auxiliary reservoir air, as in making graduated or service stops, a slight reduction of pressure in the train-pipe will cause each piston to perform a partial stroke toward the train-pipe, first closing the release port and then opening the graduating passage, when auxiliary reservoir air will flow into the brake-cylinder until the pressure on auxiliary reservoir side of piston is so far reduced that the train-pipe air will operate to move the piston and close the graduating port, but without opening the exhaust. In the patented device a preliminary movement of the main valve is involved in performing the graduating operation, and the same is true of defendants' 1889 valve; but in defendants' 1891 valve no movement of the main valve is required for this operation, the stem 18, in which the graduating port is formed, moving freely through the main valve 22; moreover, in the patent, the graduating stem *b'* serves to limit the movement of the piston in graduating, and a similar office is performed by the main valve 22 of defendants' 1891 valve. When the pressure in train-pipe is suddenly reduced to a considerable degree, or entirely, the piston of each of the triple valves referred to will be caused to make its full stroke toward the train-pipe, and, in so doing, it will first close the release valve and then withdraw or remove the main valve from the port or passage leading from the valve chamber to the brake-cylinder, so that auxiliary reservoir air will flow directly into
 1007 the brake-cylinder without being compelled to pass through the smaller graduating passages. During this movement of the piston and main valve a slight but inefficient discharge of air will take place through the graduating passages, as said passages are opened before the main valve uncovers its port.

Such would be the function and operation of the defendants' triple valve in the absence of the "partition" separating the valve chamber from the auxiliary reservoir end of the piston, and the restriction placed upon the flow of auxiliary reservoir air through said valve chamber; and the addition of those elements which contribute in establishing the momentary differential pressures in valve chamber, auxiliary reservoir and train-pipe, do not in any way change or modify the action of the triple-valve members, but merely effect the addition of train-pipe air to the auxiliary reservoir air, which latter would otherwise alone be delivered to the brake-cylinder when an emergency application of the brakes was attempted.

4.55 p. m.—Adjourned to meet at same place on Friday, May 19th, 1893, at 10.30 o'clock a. m.

10.30 A. M., MAY 19TH, 1893.

Met pursuant to adjournment.

Parties present as before.

A comparison of the mechanism of defendants' triple valve with the triple valve of patent 141,685 of August 12th, 1873, will serve to illustrate the fact that the main valve 22 of the 1891 triple valve (which operates to perform the same functions of admitting auxiliary reservoir air to the brake-cylinder upon the full stroke of the piston, and is the equivalent of main valve 15 in the 1889 triple valve) is the main valve, and corresponds in its functions with the main valve *a*, of the patent referred to. The patent shows a piston the equivalent in operation of piston 29 or 5; a feed-valve through which air is conducted to the auxiliary reservoir through the valve chamber, said feed-valve being specifically different in construction but generically an equivalent of the check-valve 26 or 11; a release valve *h'*, operated by a stem *s'*, passing through the main valve and attached to the piston, similarly to the stem 18 of defendants' 1891 valve, and serving to engage the spring-pressed release valve *h'*, the latter being of the same type and having the same mode of operation as the release valve 18 of defendants' 1889 triple valve (the equivalent of the release valve 17 in defendants' 1891 triple valve;) and a main valve *a*, of the poppet form engaging a large supply port, through which communication is established between the auxiliary reservoir and valve chamber on the one side, and the brake-cylinder on the other, just as does the main valve 22 of defendants' 1891 triple valve, said main valve of the patent being so connected to the piston that the latter may have an independent motion, to close the release valve at the beginning of the stroke of piston towards train-pipe side, and to engage and move said main valve to uncover its port during the latter portion of the stroke of said piston after the release valve has been closed; just as in defendants' 1891 triple valve. The piston and its attached stem 18 are retracted to close the release-valve port before the shoulder on the stem engages the main valve 22, to remove the latter from its port. The specific difference between the triple valve of patent No. 141,685 and defendants' 1891 valve lies in the introduction of a separate graduating valve, represented by the graduating port 40 and graduating passage in stem 18 of defendants' 1891 triple valve, to perform a part of the functions of the main valve, as described in the patent No. 220,556 of 1879. I find in patent No. 141,685 that a tapered plug *o*, was applied to the under side of the main valve *a*, for use in effecting graduating application of the brakes, said tapered plug entering the main valve port *o'* and operating to diminish the capacity of said main valve port, when the main valve was only partially unseated, and thereby diminish the amount of compressed air passing through said main valve port while graduating. In defendants' triple valve the flow of air while graduating is controlled by the graduating valve, but in effecting full application of the brakes without graduating, the main valves of both the patented and defendants' triple valve are employed

Since 1879 the graduating valve has been generally recognized as a part of the triple valve proper, and in incorporating this feature in their triple-valve structure the defendants have, in effect, removed the graduating plug of patent No. 141,685, and utilized the part corresponding to stem *s'* to perform the graduating functions, by providing said stem with a graduating port and passage.

In this comparison I have merely attempted to show that in the general features of construction the defendants' triple-valve mechanism corresponds generally though not specifically, with the device or mechanism known as the triple valve *prior* to the advent of what is now termed the "quick-action triple valve," and it is only since the latter event that a change has been made in the use of the term "triple valve" as designating a valve mechanism containing a feeding valve, a release valve, and a main and graduating valve controlling the flow of air from the auxiliary reservoir to the brake-cylinder in making graduated or service stops and emergency stops. In proof of the fact that a new name has been given to what was generally recognized as *the* triple valve of the Westinghouse system, constructed in accordance with the invention of patent No. 220,556 of 1879, I quote the following passage from page 19 of a book entitled "The Westinghouse Air-brake Company, Pittsburg, Pa., U. S. A., Instruction Book," bearing the imprint 1890.

(The right of exception to the book named is reserved by counsel for complainant; it not appearing that the book is in evidence, or that it is published under the authority of the complainant, or is an authoritative explanation of the complainants' apparatus.)

1010 "The plain automatic triple valve."

"A perspective view of the plain automatic triple valve and locomotive-tender brake apparatus, is shown in plate 1, Fig. 3, and cross-sections of the triple valve in Figs. 4 and 4a, which will clearly show its construction. It is desirable that this triple valve be perpetuated for the use with locomotive driving wheels and tender brakes, to give a slightly slower action of the brakes thereon in cases of emergency action to the quick-action apparatus on cars.

"The construction and operation of the plain automatic triple valve is substantially the same as that of the quick-action form, the quick-action valves being omitted, and pressure used only from the auxiliary reservoir in applying the brakes, and will not, therefore, require specific description."

I have examined the drawings referred to in the passages quoted, and find they illustrate the triple valve of patent No. 220,556, and it will be observed that it is here referred to as the "*plain* automatic triple valve" to distinguish it from the new valve called the "quick-action triple valve." The quick-action triple valve referred to in the instruction book is not of the form shown and described in patent No. 360,070, although possessing the functions of admitting air from the train-pipe directly into the brake-cylinder when effecting an emergency application of the brakes.

Q. 11. State whether or not you find defendants' quick-action air-brake apparatus, in either of its forms, to be an infringement of all or any of the claims numbered 1, 2, and 4, of complainants' patent No. 360,070, giving your reasons with your opinions.

(Objected to by counsel for complainants as calling for an opinion in law, and as incompetent.)

A. I am clearly of the opinion that the defendants' quick-action air-brake apparatus does not infringe either of the claims referred to in the question, and that in neither form of apparatus employed by defendant is embodied or used the combinations of devices, or their known equivalents, specified and described in the first, second and fourth claims of patent No. 360,070, and my reasons are as follows:

I will first explain what I understand to be the radical differences in structure and mode of operation between the invention of patent No. 360,070 and the apparatus as constructed and used by the defendant, and will then proceed to point out wherein the defendants' apparatus differs from the inventions recited in the claims mentioned.

According to the invention of the patent certain "additional members," of which the auxiliary valve 41 and an independent passage around the triple valve proper are essential elements, were added to the ordinary triple-valve mechanism, forming part of the ordinary automatic air-brake system, for effecting the direct admission of train-pipe air to the brake-cylinder when the triple valve was operated for effecting a quick application of the brake, as in making an emergency stop. The admission of train-pipe air to the brake-cylinder is effected by the movement of the auxiliary valve in opening the passage around the triple valve proper, and is in nowise affected by the valves of the triple valve proper these parts performing their usual functions.

Recess.

Now, the usual functions of the triple valve proper were threefold, to wit: 1st, controlling the admission of train-pipe air to the auxiliary reservoir, for charging the latter, and preventing a return of the air to the train-pipe when the pressure in the latter was reduced; 2nd, controlling the escape of air from the brake-cylinder, by opening communication with the atmosphere when releasing the brakes, and closing the escape passage when applying the brakes; and 3rd, controlling the admission of air from the auxiliary reservoir into the brake-cylinder, said control being effected in 1012 two ways and for two different kinds of applications of the brake, (a) controlling the admission of air to the brake-cylinder through the graduating passage and by the graduating valve, and (b) controlling the direct admission of air to the brake-cylinder by the action of the main valve uncovering a port opening directly into the valve chamber and holding said port open until the pressure equalized in the brake-cylinder. As the additional members of the patent 360,070 were not to effect the graduating

function, but were only to be called into action in making a full application of the brakes, the auxiliary valve was arranged in such a manner that it would be moved, to uncover passage leading directly to the brake-cylinder, slightly in advance of the action of the triple valve proper in opening the line of communication between auxiliary reservoir and brake-cylinder, as in making emergency stops; hence the auxiliary valve was arranged to be moved by the piston of the triple valve proper during the latter portion of that part of the stroke of the piston which ordinarily effected an emergency application of the brakes by opening direct communication between auxiliary reservoir and brake-cylinder, and permitting equalization of pressure in auxiliary reservoir and brake-cylinder.

It will be observed that the additional members of the patent (by which I mean the auxiliary slide-valve, the passage and the check-valve) have nothing whatever to do with the operation of the triple valve proper, and, while for convenience they were located in the casing of the triple valve proper, they might, so far as the functional performance is concerned, be made separate from the triple valve, the only necessary connection being one by which the motion of the piston would be communicated to the auxiliary valve at the proper time. Thus the triple valve proper performed *its* functions, and the additional members performed *their* functions with the result that when an emergency application of the brake was required, the triple valve proper was operated to discharge auxiliary reservoir air continuously into the brake-cylinder, and the "additional members" were operated to open another line of communication, to wit: that between train-pipe and brake-cylinder, through which train-pipe air under a lower pressure than auxiliary reservoir air would be admitted to the brake cylinder.

I am unable to find in the patent any hint or suggestion of a means or mode of operation, other than those of the "additional members," whereby the admission of train-pipe air directly into the brake-cylinder is or can be effected by the triple-valve mechanism, and without the use of a valve auxiliary to the triple valve; and the specification of the patent contains a direct implication that a triple valve proper, possessing all the functions of such a valve, is incapable of effecting the direct admission of train-pipe air into the brake-cylinder.

Turning now to the quick-action triple valves as made and used by the defendants, it appears that the results effected by the additional members of the patented device are produced in defendants' valves directly by the triple valve proper and without the addition of an extra passage or an auxiliary valve; and that the only substantial change which is required to convert a triple valve proper into what is now known as a "quick-action triple valve" is the separation of the valve chamber from the auxiliary reservoir end of the piston chamber, and the introduction of the small passage *c* (or B) through which auxiliary reservoir air is compelled to pass in entering the valve chamber. *With these changes* and the use of a check-valve for the feeding-in valve (a use which was common in the art as exhibited in numerous prior patents, as, for example,

patents Nos. 144,006 of October 28, 1873; 166,386 of August 3, 1875, and 280,285 of June 26, 1883.) *Mr. Boyden has succeeded in making a triple valve perform the operation of admitting train-pipe air directly into the brake-cylinder without interfering with its functions as a triple valve proper, and without the addition of anything corresponding in name, construction or mode of operation with the*
 1014 *auxiliary valve and its passage connecting the train-pipe and brake-cylinder, which auxiliary valve and passage constitute two of the three additional members of his patent 360,070, and are absolutely essential to the operation of the device described in the patent, when used to effect a discharge of train-pipe air directly into the brake-cylinder.*

In the complainants' patented structure, *two valves are required for effecting an emergency application of the brakes, one of said valves being the main valve of the triple valve proper by which communication is established between the auxiliary reservoir and brake-cylinder, and the other, the auxiliary valve by which communication is established between the train-pipe and brake-cylinder independently of the triple valve proper.*

In the defendants' structures, *a single valve, to wit: the main valve 15 (or 22) co-operating with a single valve port, serves to admit both auxiliary reservoir air and train-pipe air to the brake-cylinder, no additional or auxiliary valve being employed.*

In the patented device, six valves or valve functions are necessary to the performance of all the functions pertaining to the triple valve proper and to the "additional members," to wit: (1) a feeding-in valve; (2) an escape or release valve; (3) a graduating valve; (4) a main valve; (5) an auxiliary valve, and (6) check-valve. The first four of the six valves mentioned relate to the triple valve proper, and the fifth and sixth to the additional members by which train-pipe air is admitted to the brake-cylinder.

The defendants' quick-action triple valves contain only the first four valves, to wit: (1) a feeding-in valve; (2) an escape or release valve; (3) a graduating valve, and (4) a main valve, omitting entirely the fifth and sixth valves, to wit: the auxiliary valve, and the check-valve located in the passage governed by the auxiliary valve and leading from the train-pipe to brake-cylinder.

In making this comparison between the number of valves,
 1015 I have considered the graduating valve and the port at the end of the graduating passage, in the structure shown in the patent, as a single valve, although there are, in fact, two valves employed in making the graduated admission of air from auxiliary reservoir to the brake cylinder; whereas, in the defendants' structure, a single graduating valve is employed in each instance.

In the patented device it is requisite and necessary that the auxiliary valve should be moved by the piston to uncover a port for the admission of train-pipe air to the brake-cylinder; whereas in defendants' structures there are no auxiliary valves, nor is train-pipe air admitted through a passage distinct from the triple valve proper; but, on the contrary, the admission of train-pipe air to the brake-

cylinder is effected by the establishment of *momentary differential pressures* in the valve chamber and on opposite sides of the piston, which is rendered possible by the interposition of the partition separating the valve chamber from the auxiliary reservoir end of the piston chamber, and restricting the flow of auxiliary reservoir air into said valve chamber, thereby establishing conditions favorable to the entrance of train-pipe air, under less pressure than auxiliary reservoir air, into the valve chamber, where it joins the auxiliary reservoir air, and they pass together through the main valve port of the *the* triple valve proper into the brake-cylinder.

In the patented structure the auxiliary valve is distinct from the triple valve proper and its piston, and is acted upon by the latter during the latter part of its stroke, and while carrying the main valve to open communication between the train-pipe and brake-cylinder; whereas, in the defendants' structures, there is no auxiliary valve, no passage opened by an auxiliary valve, and the admission of train-pipe air to the brake-cylinder is not effected by the opening of any valve alone, nor the opening of any passage alone, as in the patented structure, but is effected by the opening of the main
1016 valve port when the structure and conditions are such that the momentary differential pressures in valve chamber and piston chamber will be produced.

4.50 o'clock p. m.—Adjourned to meet at same place on Saturday, May 20th, 1893, at 10.30 o'clock a. m.

10.30 A. M., MAY 20TH, 1893.

Met pursuant to adjournment.

Parties present as before.

In the patented device, during the *automatic* applications of the brakes, resulting from the depletion of the train-pipe, the auxiliary valve will open its port, but no appreciable amount of train-pipe air will enter the brake-cylinder, the application of the brakes being effected by the auxiliary reservoir air passing through the triple valve; and in the absence of the check-valve 49 the auxiliary reservoir air, instead of entering the brake-cylinder, would be discharged through the independent passage controlled by the auxiliary valve and escape into the train-pipe; hence the devices of the patent would be inoperative for effecting that most desirable operation of automatically applying the brakes, if the check-valve 49 were omitted.

In the defendants' triple valves the *automatic* action would take place precisely the same as with the ordinary or plain triple valve, due to the fact that the main valve controls the entrance of both train-pipe air and auxiliary air to the brake-cylinder, and the admission of train-pipe air is effected through the feeding-in valve; hence, the same conditions which effect the closing of the feeding-in port in the automatic application of the brake, prevent the return of air to the train-pipe when the pressure in the latter is entirely relieved, thereby rendering possible and practicable the utilization of auxiliary reservoir air in the brake-cylinder without the employ-

ment of a separate check-valve for preventing the discharge of auxiliary reservoir air into the train-pipe.

1017 Turning now to the claims, I do not find in defendants' quick-action air-brake apparatus, in either of the forms referred to in the question, the combination of devices specified in claim 1; for the reason that defendants' said apparatus does not contain the sixth element included in said claim, to wit: "An auxiliary valve device actuated by the piston of the triple valve and independent of the main valve thereof, for admitting air in the application of the brake directly from the main air pipe to the brake-cylinder, substantially as set forth," nor any device the equivalent of that described and referred to, operating in substantially the same manner.

The combination of the claim includes the brake-equipment of a single car, and differs from the ordinary automatic air-brake equipment made up of the first five enumerated elements only in the addition of the "auxiliary valve device," the latter being independent of the "main valve" of the triple valve proper, and so arranged that it will be actuated by the piston of the triple valve proper to open a passage between the train-pipe and brake-cylinder and admit air directly from the former to the latter. The air thus admitted by the "auxiliary valve device" is additional to the auxiliary reservoir air admitted to the brake-cylinder by the triple valve proper.

The defendants' apparatus contains the first five elements of the claim; that is to say, it has a train-pipe, means for maintaining and varying the air pressure in said train-pipe, an auxiliary reservoir, a brake-cylinder and a triple valve; but it omits the "auxiliary valve device" entirely, hence it has no such device independent of the main valve of the triple valve, nor one which is actuated by the piston of the triple valve. The results produced by all of said apparatuses are substantially the same; that is to say, each effects the admission of train-pipe air to the brake-cylinder, in conjunction with auxiliary reservoir air, when operated to effect an emergency application of the brake by a sudden and considerable reduction of pressure in the train-pipe; but in

1018 the patented device this result can only be effected by the "auxiliary valve device" of the claim acting in conjunction with the triple valve proper; whereas in defendants' apparatuses the result is effected by means of the triple valve alone, *when provided* with a partition separating the valve chamber from the piston chamber, and a restricted passage between auxiliary reservoir and valve chamber. In the one case (complainants' patent 360,070) the admission of train-pipe air is controlled by the movement of *an auxiliary valve* to open a passage independent of the triple valve proper; in the other (defendants' valve device) train-pipe air is conducted through and controlled by the *main valve of the triple valve*, and its admission is induced by the establishment of momentary differential pressures within the triple valve.

The second claim of the patent, I understand, includes a combination of five elements, of which the fifth, to wit, the "triple

valve," is not the same triple valve included under that designation in claim 1, but in the *new* triple valve composed of a triple valve proper, together with the "*additional members*" by which it is made to perform the further function of admitting air directly from the train-pipe to the brake-cylinder during that portion of the stroke performed by the piston of the triple valve proper in opening a passage between auxiliary reservoir and brake-cylinder for the continuous discharge of air into the latter.

The two forms of apparatus made by defendants contain four of the five elements of this claim, but they do not, in my opinion, make use of the fifth element, nor its equivalent, in its construction or mode of operation. The defendants' triple valves are not provided or combined with the "*additional members*" of the patent, to wit, an auxiliary valve, the passage connecting the train-pipe and brake-cylinder controlled by said valve and a check-valve governing the flow of air through said passage in one direction; nor are they provided with "*additional members*" the equivalent in construction and mode of operation of those of the patent; on

1019 the contrary, the triple valves made by defendants differ generally from the ordinary triple valves only in two particulars, to wit: The *partition* separating the valve chamber from the piston chamber and the *restricted passage* through which auxiliary reservoir air is conducted into the valve chamber, neither of which elements corresponds in function or mode of operation with the three "*additional members*," or either of them, which form part of the new triple valve constituting the fifth element in claim 2 of the patent.

It is true that the results produced by the patented triple valve and by defendants' triple valves are substantially the same; that is to say, in each air is admitted from the auxiliary reservoir to the brake-cylinder during the first portion of the traverse of the triple-valve piston, as in making graduated applications of the brake, and air from both the auxiliary reservoir and the train-pipe are admitted to the brake-cylinder during the further or final traverse of the triple-valve piston; but the means employed, and which I understand is all that the claim covers, are not the same nor equivalents. The triple valve of claim 2 operates as an ordinary triple valve and performs the two functions of effecting the admission of auxiliary reservoir air to the brake-cylinder during both the preliminary and final or complete movement of its piston, while the further function of admitting train-pipe air to the brake-cylinder is performed by the auxiliary valve and passage of the "*additional members*." In each of defendants' triple valves air is admitted to the brake-cylinder from the auxiliary reservoir during the preliminary movement or traverse of the piston, and air from both the auxiliary reservoir and train-pipe is simultaneously admitted to the brake-cylinder, *through* the triple valve and *by* the main valve thereof.

It is true defendants' triple valves are provided or formed with certain parts not found in ordinary triple valves, and which serve to effect the admission of train-pipe air to the brake-cylinder, said parts being the partition separating the valve chamber from the

1020 piston chamber, and the restricted passage through which auxiliary reservoir air is conducted to the valve chamber of the triple valve proper; but these additions do not directly effect the admission of train-pipe air to the brake-cylinder, as is the case with the "additional members" of the patent, but merely serve to assist in establishing the momentary differential pressures within the triple valve, and thus render the admission of train-pipe air *through the triple valve* possible. In the one case, that of the patented device, the "additional members" perform all the operations and possess all the requisites for effecting the admission of train-pipe air to the brake-cylinder, and they are added as a whole to the triple valve proper; whereas, in the other case (defendants' triple valve), the changes and additions made are within the triple valve proper, they are incapable alone of performing the function of admitting train-pipe air to the brake-cylinder, and their only function is to *enlarge the capacity of the triple valve* proper, so that it may perform the function of admitting train-pipe air to the brake-cylinder at the same time that it admits auxiliary reservoir air to the brake-cylinder, and by the same main valve previously employed in effecting the admission of auxiliary reservoir air alone.

Recess.

In the patented device, the quick-action functions are performed entirely by an "auxiliary valve device" superadded to the triple valve proper; whereas, in defendants' triple valve, the quick-action function is dependent upon the partition and restricted passage (or B) within the triple valve itself.

As I have hereinbefore explained, I understand the 4th claim to include a combination of five elements going to make up a triple-valve device such as that described in the patent. Of the five elements named, but three of them are found in defendants' triple valve, said three elements including the case, the piston, and
1021 the valves controlling the passages between train-pipe and auxiliary reservoir, between auxiliary reservoir and brake-cylinder, and between brake-cylinder and atmosphere, constituting the essential elements of the triple valve proper. The fourth and fifth elements of the claim, to wit: "an auxiliary valve actuated by the piston stem" and the "passages leading to connections with a main air pipe and with the brake-cylinder, respectively," which passages are controlled by the auxiliary valve, are not found in the defendants' triple valve. Defendants' triple valves are each provided with the four-valve devices and functions; these are common to the ordinary triple valve and found in the triple valve of the patent, to which last-named triple valve the auxiliary valve and its passage of patent 360,070 are additional members, and are requisite for the purpose of adding the function of direct admission of train-pipe air to the functions of the ordinary triple valve.

The auxiliary valve and the passages controlled thereby are the added elements of the patent 360,070, by which train-pipe air is admitted to the brake-cylinder during and by the movement of

the triple-valve piston; while in defendants' triple valves the partition and restricted passage *c* (or B) are instrumental in producing the momentary differential pressures in the triple valve proper, by which train-pipe air is admitted to the brake-cylinder without the interposition or use of any auxiliary valve.

Referring to each of the three claims under consideration, it is evident that as each one includes a valve which is distinct from the triple valve proper, and auxiliary to main valve thereof, and as the defendants' valves do not employ an additional valve, nor a valve auxiliary to the main valve, they do not make use of the inventions described in claims 1, 2, and 4 of the patent; and, in addition, the principle upon which defendants' valves are constructed and operated is widely different from the principle involved in the patented device.

1022 Such parts of the foregoing answer as express an opinion upon the legal question of infringement are objected to.

Q. 12. You have explained the difference between the mechanical combinations specified in claims 1, 2, and 4 of patent 360,070 in suit, on one hand, and the mechanical combinations contained in the defendants' apparatus on the other hand. Now, please explain whether the principle, or *mode of operation*, of the patented device and the defendants' device is the same or different—giving your reasons with your opinions.

A. The difference in principle or mode of operation is briefly this:

The patentee, Mr. Westinghouse, took the old-fashioned triple valve, contrived an *additional valve element*, and compelled the triple valve to actuate this additional valve element so that the latter would admit train-pipe air to the brake-cylinder under certain conditions.

On the other hand, Mr. Boyden, the inventor of the defendants' device, took the form of the old-fashioned triple valve, which had a check-valved feed-passage, and by simply *separating* the piston chamber from the valve chamber and *restricting the passage* through which air flows from the auxiliary reservoir to the valve chamber, he introduced the new principle of "momentary differential air pressures," and thereby compelled the *triple valve itself* to admit train-pipe air to the brake-cylinder without the aid of any auxiliary-valve element whatever.

In admitting train-pipe air to the brake-cylinder the device of Mr. Westinghouse acts on the mechanical principle of employing the triple-valve piston to actuate a new and additional valve element to open the passage from the train-pipe to the brake-cylinder; whereas, the device of Mr. Boyden acts on the entirely different mechanical principle of employing *differential air pressures* to actuate, not a new and additional valve element, but *the triple valve itself*, to open the passage from the train-pipe to the brake-cylinder.

1023 Mr. Westinghouse uses a new and auxiliary valve, not a part of the triple valve; Mr. Boyden utilizes the feed-valve of the old triple valve.

Mr. Westinghouse actuates his new valve by the impact of the triple-valve piston; Mr. Boyden actuates the old feed-valve, such as that of his 1883 patent, by the differential air pressure momentarily established in the triple-valve chamber.

Suppress the auxiliary valve 41, and the port 42 of the Westinghouse device, and there can be no quick action nor admission of train-pipe air directly into the brake-cylinder, although the triple valve will, in other respects, act as before; suppress the partition 9 in the Boyden device, and there can be no quick action nor admission of train-pipe air directly into the brake-cylinder, although the triple valve will, in other respects, act as before. In the one case (Westinghouse device), therefore, the auxiliary valve 41 and its port 42 constitute the quick-action device as distinguished from the old triple valve; in the other case (Boyden device), the partition 9 and its restricted passage *c* (or B) constitute the quick-action device as distinguished from the old triple valve.

It is perfectly obvious that the difference in principle or mode of operation is world-wide between a movable valve and its port, on the one hand, and an immovable partition having a restricted opening through it, on the other hand. This difference of principle, in the two devices under comparison, is fundamental, completely distinguishing the one from the other, having no common analogy or resemblance, and rendering it necessary to assign the two inventions to entirely different classes or categories when looked at from a mechanical point of view.

3.30 p. m.—Adjourned to meet at same place on Monday, May 22d, 1893, at 10.30 a. m.

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10.30 A. M., MAY 22d, 1893.

Met pursuant to adjournment.
Parties present as before.

Q. 13. Mr. Boyden, in his testimony, has referred to the fact that certain tests or experiments were recently made at the works of the Boyden Brake Co., in this city, at which you were present. Please give the history of those tests, and state what conclusions are to be drawn from them; giving your reasons.

(Objected to, the practical knowledge of the witness of the subject inquired about not having been shown; he, therefore, being incompetent to testify in regard to experiments and their practical results or bearing upon this case.)

A. The tests referred to were conducted at the works of the Boyden Brake Co., April 25, 1893, and were made for the purpose of demonstrating, practically, that the conversion of the ordinary triple valve into a quick-action triple valve operating on the principle of defendants' was due to the presence of the partition 9 and the restricted passage *c*, or B.

For testing the action of the triple valve there was used an air pump or compressor, a main air reservoir, a section of train-pipe,
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an engineers' valve, an auxiliary reservoir, a brake-cylinder and piston, and triple valves such as I shall refer to. The apparatus represented the equipment of a single car, and in the branch pipe connecting the train-pipe and triple valve there was inserted a glass section containing a wooden ball, said glass section being slightly inclined to the horizontal so that the ball would be held against the inlet end, or that nearest the train-pipe, and would be carried up the incline by the admission of train-pipe air through the branch-pipe.

The first experiment involved the use of Defendants' Exhibit B, of which a section is shown in Defendants' Exhibit C. These exhibits illustrate the application of the main valve, with its
 1025 graduating valve, of patent No. 220,556 of 1879, used in connection with the piston, partition 9 and feeding-in valve 11 or 26 of defendants' triple valve—the main slide-valve and graduating valve of said patent 220,556 replacing the release, main and graduating valves of defendants' devices; or, to state it another way, the exhibits represent those valves of the patent 220,556 which control the release port and the two lines of communication between the auxiliary reservoir and brake-cylinder, while the actuating piston and feeding-in valve of the patent 220,556 are replaced by the actuating piston and feeding-in valve of defendants' triple valve, together with the partition 9 separating the valve chamber from the piston chamber. In each experiment the auxiliary reservoir was first charged with air at maximum pressure.

Upon slightly and gradually reducing the pressure in train-pipe by means of the engineers' valve, as in making graduated applications of the brake, the piston was moved to close the escape port, open the graduating passage in main valve and unseat the graduating valve; whereupon, auxiliary reservoir air passed to the brake-cylinder, and the reduction of pressure on auxiliary reservoir side of piston occasioned by the expansion of air into the brake-cylinder advanced the piston and closed the graduating valve against its seat, without moving the main valve to uncover the exhaust, thus holding the limited air pressure within the brake-cylinder. A further slight reduction of pressure in the train-pipe served to unseat the graduating valve, thereby admitting more air and increasing the pressure in the brake-cylinder. The re-establishment of maximum pressure in train-pipe forced the piston towards auxiliary reservoir, uncovering the release or exhaust port and recharging the auxiliary reservoir through the feeding-in valve.

When the pressure in train-pipe was reduced gradually and continuously, by a graduated discharge of air through the graduating port of the engineers' valve, the triple-valve piston operated to first close the exhaust, then open the graduating passage, and
 1026 finally to uncover the main port leading from the valve chamber to the brake-cylinder.

When, however, the pressure in train-pipe was suddenly reduced between fifteen and twenty pounds, the triple-valve piston made its full stroke towards the train-pipe side, instantly uncovering the main-port opening from valve chamber to brake-cylinder, and the wooden ball in the glass section of train-pipe was projected towards

the triple valve, thereby demonstrating the fact that *train-pipe air was admitted* to the brake-cylinder through the only avenue open in the triple valve, to wit, through the feeding-in passage to the valve chamber, and thence to the brake-cylinder. Such a movement of the wood ball did not take place in either of the previously described experiments.

The next experiment was made with the same triple valve, Exhibit B, but with the partition or bushing surrounding the hollow stem of the valve piston removed, thus placing the valve chamber in open and unrestricted communication with the auxiliary-reservoir end of piston chamber. The graduated application was made, as before, by a slight reduction of pressure in the train-pipe, and successive graduated applications were made by successive slight reductions of pressure in the train-pipe. When, however, the auxiliary reservoir having been recharged, train-pipe pressure was suddenly reduced from fifteen to twenty pounds, and the piston was suddenly retracted to uncover the passage or port opening from the valve chamber to the brake-cylinder as before, no movement of the wooden ball took place, notwithstanding the fact that the piston of the brake-cylinder was instantly projected; thereby proving that *no* train-pipe air was admitted to the brake-cylinder, and that auxiliary reservoir air *alone* operated in the brake-cylinder.

The next series of experiments were performed with defendants' Exhibit A, representing the quick-action triple valve of defendants' 1891 catalogue. The apparatus employed was the same as 1027 used in the preceding experiments, Exhibit A being substituted for Exhibit B.

The Exhibit A was first used in its complete condition, and, the auxiliary reservoir being charged and maximum pressure established in train-pipe, a slight and gradual reduction of pressure being effected in train-pipe through the engineers' valve, the triple-valve piston was retracted until the shoulder on the stem engaged main valve 22, thereby closing the release port and opening communication between valve chamber and brake-cylinder through the graduating port. As the pressure of auxiliary reservoir air diminished by expansion into the brake-cylinder, the valve piston moved towards the auxiliary reservoir side until the graduating port entered the main valve, and was closed thereby. A further slight reduction in pressure in train-pipe operated to withdraw the graduating port temporarily from within the main valve and effect a further admission of auxiliary reservoir air to the brake-cylinder. A slow and continuous discharge of air from the train-pipe through the graduating port of the engineers' valve, by which the gradual reduction of pressure in the train-pipe was effected, operated upon the piston of the triple valve to first close the release valve, then open the graduating valve, and finally unseat the main valve. During these operations no movement of the wooden ball was observed.

When the pressure in train-pipe was suddenly and considerably reduced—say from fifteen to twenty pounds—the piston of the triple valve was instantly moved its full stroke, closing the release port and unseating the main valve, and *the wooden ball was instantly*

driven toward the triple valve, thus showing that air from the train-pipe had entered the brake-cylinder by the only passage through which it could enter, to wit, the feeding-in passage, valve chamber and port uncovered by the main valve.

In the fourth experiment Exhibit A was again used, but *without the bushing or partition* which surrounds the hollow valve stem, and which before served to separate the valve chamber from the auxiliary reservoir end of piston chamber; this placed the valve chamber in open and free communication with the auxiliary reservoir. The action of the apparatus was unchanged so far as the operations of graduating were concerned; that is to say, when the pressure in train-pipe was slowly and slightly reduced, or slowly and considerably reduced. But when the pressure in train-pipe was suddenly and considerably reduced, the valve piston made its full stroke, closing the release valve and unseating the main valve, thereby quickly charging the brake-cylinder from the auxiliary reservoir alone and without any admission of train-pipe air, as shown by the wooden ball, the latter remaining in position at the train-pipe end of the glass section.

In the fifth experiment the partition was inserted, and the graduating valve removed, which was done by substituting a blank stem, *i. e.*, one having no graduating port or passage. With the triple valve thus altered and *deprived of its separate graduating valve*, graduated applications were made by slow and partial reductions of pressure in the train-pipe, the main valve of the triple valve being but slightly moved from its seat, so that but a limited passage was opened through which auxiliary reservoir air was gradually admitted to the brake-cylinder. When, however, the pressure in train-pipe was suddenly and considerably lowered, the piston of the triple valve made its full stroke, moving the main valve from its seat, and opening wide the large port leading from the valve chamber to the brake-cylinder, and the ball in the glass cylinder was instantly projected towards the triple valve, showing that train-pipe air had entered the triple valve and been discharged into the brake-cylinder.

The sixth experiment was performed with Exhibit A, containing the blank stem as in the fifth, but with the partition removed, and the valve chamber in open and unrestricted communication with the auxiliary reservoir. Graduated applications of pressure in the brake-cylinder were performed as in the fifth experiment, the main valve being but slightly raised from its seat. When the pressure was suddenly and considerably reduced in the train-pipe, the valve piston made a full stroke, unseating the main valve and opening wide the large port leading to the brake-cylinder; whereupon, air from the auxiliary reservoir was instantly discharged into the brake-cylinder, as indicated by the movement of the brake piston, but no train-pipe air was admitted, the wooden ball remaining stationary.

These experiments confirmed the views I have expressed, and satisfactorily demonstrated the fact that the *separation* of the valve chamber from the auxiliary reservoir end of the piston chamber,

and the *restricted passage* through which auxiliary reservoir air is conducted to the valve chamber, *constitute the quick-action elements* of the Boyden quick-action triple valve, and that the introduction of the principle of "momentary differential pressures" is all that distinguishes the Boyden quick-action triple valve from the ordinary triple valve, and from the triple valve proper of patent No. 360,070.

The experiments made with Exhibit B serve to demonstrate the fact that the particular form of triple valve proper illustrated in patents 360,070 and 220,556 perform the same operations and are generically the equivalent of Mr. Boyden's triple valve when the quick-action principle of momentary differential pressures, invented by Mr. Boyden, is absent, as when the partition and restricted passage are omitted.

Comparing Exhibit B without partition, and Exhibit A without partition, each exhibits all the elements of an ordinary or plain triple valve; that is to say, each has a controlling piston, a feeding-in valve, a release or exhaust valve, a graduating valve and a main valve, and each is adapted to perform graduated applications of pressure and quick applications of pressure, but without the admission of train-pipe air directly to the brake-cylinder. When, however, the bushing or partition and restricted passage are introduced, each of said ordinary triple valves is at once converted into a quick-action triple valve without further change or modification in structure, or the addition of any new valve element.

Recess.

The experiments made with Exhibit A when deprived of its graduating valve by the introduction of the blank stem, demonstrate two things: First, that the removal of the graduating valve converts the triple valve into one of the kind known and used prior to 1879, as exhibited; for example, in the Westinghouse patents Nos. 141,685 of 1873, 144,006 of 1873, 168,359 of 1875, and 172,064 of 1876, and the Jones patent No. 166,386 of 1875, in all of which the main valve is used for both graduating and full applications of pressure; thus the main valve of Exhibit A is similar in construction and mode of operation to the main valves of patents 141,645 and 144,006, equivalents of which are found in the main slide-valves of patents 168,359 and 172,064; and, secondly, that the old triple valve, with its main valve performing both the graduating and full applications of pressure, is converted into a quick-action triple valve by the introduction of the partition or bushing and the restricted passage between auxiliary reservoir and valve chamber.

The experiments further demonstrate that in the Boyden triple valve the valve marked 22 in defendants' 1891 catalogue, is the main valve controlling the flow of air between auxiliary reservoir and brake-cylinder; that the graduating valve, formed by the port 40 and passage in the piston stem, performs part of the function which would be performed by the main valve in the absence of the graduating valve, and to this extent contains the improvement in-

troduced by patent No. 220,556 of 1879, wherein the graduating valve was made to perform those parts of the main-valve functions which pertain to graduation; that all of the functions pertaining to the triple valve proper, whether provided with a separate graduating valve or not, are performed just the same in the absence of the quick-action features as with the quick-action features added; and that by the addition of the partition or bushing and the restricted passage, and without otherwise changing the functions of the old triple valve, the admission of train-pipe air is effected, and the old triple-valve mechanism is thereby converted into what is now known as a "quick-action triple valve."

During the experiments made with Exhibits A and B, the positions occupied by the main and graduating valves, and by the main valves when the graduating valve was omitted, were observed through the glass windows inserted in the casings of said exhibits.

The answer is objected to generally, as stating nothing pertinent to the issue; and specifically as predicated upon experiments made with a disconnected and incomplete apparatus and not a full train equipment; as based upon certain tests made with devices having an element or elements foreign to the triple valve practically used by the defendants; and upon other tests made with devices having omitted therefrom an element or elements necessarily entering into the defendants' triple valve.

Q. 14. The complainants' expert, Mr. Newbury, in his testimony in this cause, has endeavored to establish the theory that the main valve 22, of the defendants' triple valve, is to be regarded as the mechanical equivalent of the auxiliary valve 41 of the patent in suit, and that it does not correspond to the main valve 11 of the Westinghouse patent No. 220,556. What comments have you to make on Mr. Newbury's theory?

A. Mr. Newbury has sought to convey the impression in his testimony that the quick-action triple valve of patent 360,970 is adapted to perform three classes of work, namely, "graduating," "service stop" and "emergency stops," and that the ordinary triple valve, whether of the form shown in patent No. 220,556 or other known form, is capable of performing but two of the three enumerated classes of work, to wit, "graduating" and "service stops."

1032 In my opinion, Mr. Newbury is in error, and the facts do not justify his conclusions.

The ordinary triple valve is constructed and adapted to perform all of the operations included under the three-fold classification, and the difference between the operation of the quick-action triple valve and the ordinary or plain triple valve of the 1879 patent is one of degree.

In so far as the action of the ordinary or plain triple valve is concerned, in effecting the application of the brake, there are practically but two classes of work performed, and into these time and pressure enter as the distinguishing elements. The two are: First, maximum pressure and minimum time, effected by opening communi-

cation between the auxiliary reservoir and brake cylinder *instantly*, and utilizing auxiliary reservoir pressure *fully* in the brake-cylinder; and, secondly, a more gradual application of pressure, performed in a longer period of time, and effected by a gradual, intermittent, or continuous discharge of air from the auxiliary reservoir into the brake-cylinder. Take, for example, the ordinary triple valve as exhibited in patents No. 220,556 of 1879 and No. 172,064 of 1876; if an emergency arise, demanding that the brake be *instantly applied with full power*, to effect a sudden stoppage of the train, the pressure of air is suddenly and considerably or entirely reduced in the train-pipe, with the result that the piston of the triple valve makes its full stroke, uncovering and holding open the passage C from the valve-chamber to the brake-cylinder, and permitting the auxiliary reservoir air to flow directly into the brake-cylinder until the pressures are equalized; these are the conditions and operations performed in making the quickest stop possible with such apparatus; it is known as an "emergency stop." To effect an application of the brakes less sudden and violent than the emergency stop, as in slowing up or making an ordinary service stop, the brakes are applied by a gradual intermittent or continuous admission of auxiliary reservoir air to the brake-cylinder, 1033 according to the work to be performed; but in every such case, whether the result be a full or partial application of the braking force, a longer interval is required. Thus, if it is desired to apply the brakes while running down grade, a slight and gradual reduction of pressure is made in the train-pipe, and a graduated quantity of air is discharged from the auxiliary reservoir into the brake cylinder *by graduation*, which is effected by such reductions of pressure in the train-pipe as will open the graduating passage in the main valve of the 1879 patent, or so far retract the main valve of the 1876 patent as to only partially and temporarily uncover the passage leading to the brake-cylinder. The amount of pressure thus applied in the brake-cylinder may be increased by successive graduations, or by a continuous discharge of auxiliary reservoir air through the graduating passage, or the restricted opening formed by the partial uncovering of the port by the main valve; but in either event a longer interval of time must elapse before the pressure in brake-cylinder equalizes with that in the auxiliary reservoir, than in the case of an emergency stop. Now, the amount of pressure required or employed for checking the speed of the train, or bringing it to a full stop, depends largely upon circumstances—it may require the maximum of auxiliary reservoir air, or any degree under that; and as all applications of the brakes with less than the maximum power, when performed in the shortest possible time, are subject to the control of the engineer, both as to degree of power and time of application, they are properly classed as graduating operations, whether for retarding or stopping the train.

According to Mr. Newbury's classification, the gradual application of pressure is "graduating" when employed to reduce the speed of the train without stopping it, and is a "service stop" if the train is stopped; and he has entirely ignored the action of the

ordinary triple valve *when used in an emergency* or when "automatically" operated to apply the brakes with maximum power in the shortest possible time.

1034 If Mr. Newbury's classification is adopted, it must be with the understanding that the third class, to wit: "emergency stops," are performed by the old triple valve just as much as by the quick-action triple valve, and that the only difference between the emergency stop of the quick-action triple valve and that of the ordinary triple valve has relation to the *increase* in power and the *quicker* serial application of the brakes on the train of cars.

Take, for example, the triple valve of patent No. 220,556 as employed in the patent 360,070. When an emergency stop is made by the sudden and considerable reduction of pressure in the train-pipe, the piston of the triple valve instantly makes the full stroke and opens direct communication between the auxiliary reservoir and brake-cylinder. In the absence of the auxiliary-valve device of patent 360,070, this would represent the condition under which maximum pressure could be applied in the shortest possible time, and the only difference effected by the auxiliary-valve members is the utilization of a portion of the train-pipe air in the brake-cylinder, and the depletion of the train-pipe, to quicken the action of the triple valve on the next succeeding car. Under these circumstances, the action of the triple valve proper in performing an "emergency stop" is the same whether the auxiliary-valve members are present or not, and when present, the maximum power developed is *increased* by the admission of train-pipe air and the serial action of the several triple valves in the train is *quicken*ed.

In referring to the defendants' quick-action triple valve, Mr. Newbury has again ignored the third class of work, to wit: "emergency stops," as properly belonging to the triple valve proper. Defining the triple valve proper as one capable of performing the two classes of work which he calls "graduating" and "service stops" (which classes of work I have termed "graduating," inasmuch as they are performed through the medium of the graduating valve, or the main valve when operated to partly or temporarily

1035 uncover its port), he has selected the graduating valve 40 of defendants' 1891 catalogue, and the graduating valve 13 of defendants' 1889 catalogue, and, properly attributing those two classes of work to the performance of said graduating valve, he has undertaken to say that said graduating valves are the main valves, and that the valve 22 is a valve auxiliary to *his so-called main valve*, whose function it is to open communication between the train-pipe and the brake-cylinder.

I most emphatically disagree with Mr. Newbury on this point, and my reasons are as follows:

First. The graduating valve of defendants' quick-action triple valve performs *only* the function of the graduating valve of patent 220,556, while the main valve 22 performs the functions of the main valve H in said patent when operated to uncover the passage leading to the brake-cylinder. The graduating valve in defendants' triple valve operates during the first portion of the stroke of piston, to

effect a gradual admission of air to the brake-cylinder, as does the graduating or auxiliary valve of patent 220,556; the main valve 22 is unseated during the latter portion of the full stroke of the piston, and is held removed from its port to allow the free passage of auxiliary reservoir air to the brake-cylinder, just as is the main valve H of patent 220,556, moved to uncover its port during the latter part of the full stroke of its piston.

Remove the graduating valve in defendants' device, and the graduating valve of patent 220,556, and all the graduating functions will be performed in both by the main valve, as in patent 172,064 of 1876, as well as the functions performed in effecting an emergency stop.

Adjourned to meet at same place on Tuesday, May 23rd, 1893, at 10.30 o'clock a. m.

10.30 A. M., MAY 23RD, 1893.

Met pursuant to adjournment.

Present: J. Snowden Bell, Esq., of counsel for complainants, and same counsel as before on behalf of defendants.

1036 Second. The main valve 22 of defendants' quick-action triple valve is situated in the direct line of communication between the auxiliary reservoir and brake-cylinder, and is the valve opened during the last portion of the stroke of valve piston, and it is the medium by which communication between the auxiliary reservoir and brake-cylinder is opened when the brakes are "automatically" applied, corresponding in all these particulars with the main valve of the ordinary triple valve, whether provided with a separate graduating valve or not.

Third. The main valve 22 of defendants' device can in no sense be considered as *auxiliary* to the triple valve proper of which it forms a component part; nor can it be regarded as in any sense auxiliary to a triple valve proper of the kind illustrated in patent 360,070, containing both a main and a graduating valve for admitting air from the auxiliary reservoir, to the brake-cylinder.

Mr. Newbury appears to have practically ignored the fact that the triple valve proper, of patent 360,070, (it being the triple valve proper known as the "ordinary" or "plain triple valve" and exhibited in patent 220,556) contains two valve devices controlling admission of auxiliary reservoir air to the brake-cylinder, the one represented by the graduating valve and the other represented by the main valve to which the graduating valve is "auxiliary" in the sense that it performs part of the functions previously performed by the main valve of prior structures; and, further, that the auxiliary valve device of patent 360,070 is *auxiliary* to and supplements the action of an ordinary or plain triple valve containing both the main and graduating valve. Inasmuch as the graduating valve of defendants' triple valve performs the ordinary graduating functions, and the main valve, so far as it controls communication between the auxiliary reservoir and brake-cylinder, performs substantially the same function in this particular as does the main valve of the ordinary triple valve shown in patent 360,070, said main valve 22

in defendants' triple valve cannot properly be said to be an
 1037 *auxiliary valve device*, or a valve device *auxiliary* to itself
 simply because advantage is taken of its normal operation to
 bring about the momentary differential pressures by which the ad-
 mission of train-pipe air is induced and rendered possible.

Q. 15. Is a braking force, which is just sufficient to stop a train
 of cars running at a given speed on a level track, sufficient to stop
 the same train, running at the same speed, on a down grade?

(The foregoing question, while included in the general objection
 of incompetency first entered during the deposition of this witness,
 is more particularly objected to as being an entirely improper at-
 tempt to establish, by the theories of one not shown to have any
 practical knowledge whatever of the subject-matter, some view of
 counsel, the correctness or incorrectness of which can only be prop-
 erly shown by the testimony of those who can and do give the re-
 sults of actual experience and practical tests as matters of absolute
 fact, and not in anywise matters of mere theory.)

A. No; and this illustrates the absurdity of Mr. Newbury's classi-
 fication of work performed by the ordinary triple valve, for, all the
 conditions being the same (the pressure in the brake-cylinder being
 the same and the engineers' valve operated the same), when running
 down the hill without stopping, the work performed would, accord-
 ing to Mr. Newbury, be "graduation," and the same work performed
 on a level, and resulting in the stoppage of the train, would be
 classed as a "service stop." In each case there would be a *graduated*
 application of the pressure, and the results would differ by reason
 of the different conditions under which the brakes were applied.

Defendants' counsel offers in evidence, to be marked Defendants'
 Exhibit Westinghouse 1890 Instruction Book, the instruction book
 referred to by Mr. Church in his answer to the tenth interroga-
 tory.

1038 Also, to be marked Defendants' Exhibit Westinghouse
 1886 Instruction Book, the instruction book referred to by
 Mr. Church in his answer to the sixth interrogatory.

Also, Defendants' Exhibit No. 141,685, a copy of the patent issued
 to George Westinghouse, Jr., dated August 12, 1873, No. 141,685.

Also, as Defendants' Exhibit No. 166,386, a copy of the patent
 issued to W. D. Jones, dated August 3, 1875, numbered 166,386.

Also, as Defendants' Exhibit No. 166,405, a copy of the patent
 issued to H. L. Perrine, dated August 3, 1875, and numbered
 166,405.

Also, Defendants' Exhibit No. 172,064, a copy of the patent issued
 to G. Westinghouse, Jr., dated January 11, 1876, and numbered
 172,064.

Also, as Defendants' Exhibit No. 235,922, a copy of the patent
 issued to George Westinghouse, Jr., dated December 28, 1880, and
 numbered 235,922.

Also, as Defendants' Exhibit No. 243,415, a copy of the patent

issued to George Westinghouse, Jr., dated June 28, 1881, and numbered 243,415.

The patent exhibits above referred to are copies of the specifications and drawings printed by the Government, but do not contain the patent head.

It is stipulated by and between the counsel for complainants and defendants, respectively, that the several exhibits which have been or may be offered in evidence by the parties to this cause, may be retained in the custody of the party offering them, subject at all times to the inspection of the opposite party, his counsel or experts, until the hearing of the cause.

Cross-examination *de bene esse* by J. SNOWDEN BELL, Esq., of counsel for complainants, reserving objections taken:

Counsel for complainants gives notice that at or prior to the hearing motion will be made to strike from the record the entire deposition of the witness, as being incompetent and unwarranted in this cause, and proceeds with the cross-examination, subject to such notice and the objections heretofore taken.

Counsel for defendants gives notice that at or prior to the hearing motion will be made to strike from the record the entire deposition of the complainants' expert, so called, Mr. Henry F. Newbury, upon exactly the same grounds upon which the complainants' counsel objects to the deposition of Mr. Church—both experts having apparently the same qualifications, so far as concerns their practical experience in the matter of air brakes.

16 X Q. In view of the close correspondence between the theories enunciated by you in your deposition-in-chief and those of defendants' witness, George A. Boyden, who immediately preceded you, it would seem that prior to giving your deposition you had made yourself fully familiar with that of Mr. Boyden. Is this the fact?

A. I have frequently consulted with Mr. Boyden on the subject of air brakes generally, and especially with reference to the subject-matter of this case, and was present during most of Mr. Boyden's examination and cross-examination, and to this extent your assumption is correct.

17 X Q. Your answer seems to embody some sort of a qualification. Is it not the fact that you are and were at the time of commencing your deposition fully familiar with that of Mr. Boyden?

A. I may say that I think I am fully acquainted with what Mr. Boyden testified to, and was familiar with it at the time my testimony commenced, having heard most of it given.

18 X Q. Such being the fact, please state whether you agree with or differ from the several theories and opinions enunciated by Mr. Boyden in his direct and cross-examination, and if you shall say you differ from him, please indicate in what particular or particulars.

(Objected to, as an improper mode of cross-examination.
1040 Counsel should point out the particular "theory" to which he refers, and if he refers to several, he should specifically

point out each, and direct the witness' attention to them. It is not proper to ask the witness to analyze a deposition of some hundreds of pages in answer to a question of this indefinite and unusual character; and defendants' counsel instructs the witness that he is not obliged to answer the question unless complainants' counsel shall state or point out the particular alleged "theories" to which he refers.)

(Counsel for complainants, protesting against the above instruction to the witness as being an attempted violation of the right of cross-examination, states that he refers to *all* the several theories and opinions enunciated by Mr. Boyden in his direct and cross-examination, and submits to the court that in view of the perfect familiarity of the witness with the deposition of Mr. Boyden, as indicated not only by the close correspondence of the witness' expressed views with those expressed by Mr. Boyden, but also of the witness' own admission, he deemed it wholly unnecessary and nothing but a waste of time to rehearse *seriatim* Mr. Boyden's theories and opinions.)

(Defendants' counsel renews his objections and instruction. He does not question the right of complainants' counsel to cross examine as to the agreement or disagreement of this witness with the testimony of Mr. Boyden; but he does question the right of complainants' counsel to throw a whole deposition at the witness at once, and require him to study it over and find every theory or opinion in it, and comment upon it. If he wants to know whether the witness agrees or disagrees in any particular theory expressed by Mr. Boyden, he should find the theory himself and call attention to it in his interrogatory.)

1041 A. I have not so carefully analyzed and reviewed Mr.

Boyden's testimony as to enable me at this time to separate and classify those parts referred to as his opinions and theories, but I believe that, taken as a whole, his deposition is correct.

19 X Q. In order to refresh your weakened recollection, I will refer you to Mr. Boyden's answer to X Q. 193, and ask you whether or not you believe that answer to be correct.

(Objected to, on the ground that complainants' counsel has not, in his interrogatory, called attention to any alleged "theory" of Mr. Boyden, but to an answer given by Mr. Boyden to a question calling for a mere statement of fact, and not theories. Also further objected to as indefinite and obscure. If this interrogatory means to ask the witness whether Mr. Boyden was correct in testifying to what he "intended" by his "answer 7," then the question is further objected to as incompetent, because this witness is not qualified to state what Mr. Boyden intended by his answer 7, as referred to in cross-interrogatory 193 of Mr. Boyden's deposition.)

A. I have examined Mr. Boyden's answer to X Q. 193 in connection with the question to which it has reference, and I find both question and answer to relate to two subjects of inquiry. The first subject has reference to counsel's understanding of a statement

contained in answer 8 of Mr. Boyden's deposition, wherein the latter says that he had reference to his patent No. 280,285 when he stated that his 1883 patent was not for what is now known as a quick-action valve. I believe Mr. Boyden's statement concerning counsel's understanding of this branch of the question to be correct, and the fact to be as stated.

The second subject relates to a further understanding of counsel to the effect that a certain statement concerning the valve device of plate XI defendants' 1891 catalogue, was not intended by the witness, Mr. Boyden, to mean certain things stated in the 1042 question X Q. 193; and I believe Mr. Boyden's answer, both as to counsel's understanding and the witness' intention, was correct. As to the fact, I would say that the valve device *plate of XI*, defendants' 1891 catalogue, belongs to the class of what are now known as quick-action triple valves. The triple valve of patent No. 280,285 does not fall within the category of what is now known as the quick-action triple valve, nor does it operate to effect the application of the brake with maximum rapidity and force by or through a primary and direct admission of train-pipe air to the brake-cylinder as the result of a reduction of train-pipe pressure; but it does contain and exhibit a triple-valve device provided with a check-valved feeding-in passage through which the train-pipe air is conducted both to the auxiliary reservoir, when feeding, and to the brake-cylinder, direct when applying pressure, and it also contains a main valve controlling the admission of both auxiliary reservoir air and train-pipe air to the brake-cylinder.

Recess.

20 X Q. In view of your last preceding answer I presume you will agree with me the following statement which I quote from the inset printed in red ink commencing page 2 of defendants' 1891 catalogue is an incorrect and untrue statement, to wit:

"The Boyden Quick-action Valve.

"One of the features of this valve is the provision for passing compressed air to the brake-cylinder direct from the train-pipe in automatic brakes. This feature is covered by U. S. patent issued to George A. Boyden, June 26th, 1883, and reissued April 2nd, 1889, No. 10993. For the said feature this is the foundation patent."

Am I correct?

(Objected to as immaterial, irrelevant and incompetent. The issue in this suit is not upon the claim of the Boyden patent originally issued June 26th, 1883, and reissued April 2nd, 1889, 1043 but upon the Westinghouse patent No. 360,070. The passage quoted by counsel does not declare that said Boyden patent is for a quick-action valve, but that it contains a feature which it does cover and for which it is the foundation patent; and then continuing, it gives a copy of two claims contained in the reissue and covering that feature. The validity of those claims is not in

any way in question in this suit, and it is altogether improper and irrelevant to extend the cross-examination into such an inquiry, especially as the subject of the inquiry forms no part of the examination-in-chief.)

(Counsel for complainants objects to and protests against the plain instructions to the witness contained in the foregoing objection of defendants' counsel.)

A. I do not observe that the statement quoted is necessarily incorrect and untrue. On the contrary, it would appear to be a correct statement, so far as I have examined into the subject of the Boyden reissue patent mentioned in the quotation.

21 X Q. The frequent consultations with Mr. Boyden with reference to the subject-matter of this case, mentioned in your answer 16, were held prior to the commencement of Mr. Boyden's deposition in this case, were they not?

A. Most of them were.

22 X Q. Did Mr. Boyden consult or confer with you relative to the subject-matter of his deposition during the progress of said deposition or during the adjournments that were made from time to time therein?

A. I cannot say that he did, although the subject-matter of this case has frequently been referred to and various matters discussed. If you mean to imply that I in any way, directly or indirectly, influenced Mr. Boyden's testimony while he was on the stand, I answer decidedly that I did not to the best of my knowledge and belief.

1044 23 X Q. I do not mean to *imply* anything, but simply want to inquire whether or not any communications were had between yourself and Mr. Boyden during the pendency of his deposition in this cause in, from or by which he received from you any advice, information or suggestions bearing upon the subject-matter of his testimony. If I have made the question sufficiently plain, I would be glad if you will answer it, with the understanding that I consider Mr. Boyden's deposition as pending until he has signed it and left the stand.

A. I have talked with Mr. Boyden in a general way, but to a very limited extent, about his testimony, having reference to testimony given and not to testimony to be given at any period during his examination, and such conversations as I have had, have been during the lunch recess, and have not been in the nature of advice, information or suggestions proceeding from me, but have been, so far as I can remember, more in the nature of requests on my part for information as to the meaning of his answers, and as to facts pertaining to the practical use and operation of the defendants' quick-action triple valve. I do not call to mind any occasion or any conversation in which I gave Mr. Boyden any advice, information or suggestion bearing upon the subject-matter of his testimony, or which did or could influence the same.

24 X Q. Are you willing to answer and will you answer X Q. 23 categorically in the negative?

A. I am unable to answer it categorically for the reason that I do not know whether or not anything I may have said, may have been of such a nature as to have operated upon Mr. Boyden's mind as advice, information or suggestion; but I do know this, that whatever I may have said in general conversation was not intended and I do not believe operated to affect Mr. Boyden's testimony.

25 X Q. Was not your object, in making the requests to Mr. Boyden, "for information as to the meaning of his answers, and as to facts pertaining to the practical use and operation of the
1045 defendants' quick-action triple valve," referred to in your answer to X Q. 23, to enable yourself to state to the court as *your* testimony, such information as to the subject-matter of Mr. Boyden's answers and the defendants' quick-action valve as you might derive from hearsay statements of Mr. Boyden. If this was *not* your object please state what your object was in making these requests.

A. Such was *not* my object. Some of Mr. Boyden's answers were obscure, to my understanding, and I may have asked him what he meant; and the requests for information as to facts pertaining to the practical use and operation of defendants' quick-action triple valve had reference particularly to the triple valve of defendants' 1889 catalogue, a sample of which I do not remember to have seen, although I have understood from the beginning that it contained more than one passage *e*. As the drawing referred to shows but a single passage *e*, I questioned Mr. Boyden to ascertain if my recollection and understanding was correct in this that the triple valve as actually constructed by the defendants did in fact contain more than one such passage, and did involve the principle of "momentary differential pressures;" to which Mr. Boyden replied in the affirmative. I do not now recall asking for any information or obtaining any facts with which I was not previously acquainted. So far as I was aware no inhibition has been placed upon Mr. Boyden or myself concerning the discussion of the subject-matter of this suit, and had there been I should probably have been notified of the fact, and would then have refrained entirely from any discussion of the subject-matter of this suit while Mr. Boyden remained upon the stand.

26 X Q. Then as I understand your last preceding answer, your statements-in-chief as to the quick-action triple valve of defendants' 1889 catalogue instead of being wholly statements of facts within your own knowledge, are partially based upon hearsay, to wit, information received from Mr. Boyden. Is this the fact?

A. They are partially based upon the testimony given by
1046 Mr. Boyden concerning the actual construction and arrangement of parts in the triple valve *as actually made* by the defendants and represented in the 1889 catalogue.

27 X Q. Do you understand it to be your duty or your right when assuming to testify as a mechanical expert to clear up the obscurity of the answers of another witness, and more particularly when you are not interrogated as to the correctness of his answers?

A. I do, if by so doing I can throw light on the subject under consideration, and concerning which I have been interrogated.

But in the present case I have merely sought to make clear and distinct my meaning and understanding, and I do not know that I have cleared up the obscurity of the answers of another witness.

28 X Q. At and prior to the time that you began to request information from Mr. Boyden as to the meaning of his answers, and as to facts pertaining to the practical use and operation of defendants' quick-action triple valve, as stated in your answer 23, had your readings and studies on the subject of air brakes been limited to such a degree that it was necessary for you to get this information from Mr. Boyden in order to enable you to testify as a mechanical expert?

A. It had not, and I merely asked him, to confirm my information on the subject.

29 X Q. Referring now to your consultations with Mr. Boyden prior to the commencement of his deposition, were the views and opinions expressed by Mr. Boyden derived from information or advice to such effect imparted by you to him in such consultations?

A. I have had, during the past two years, several extended consultations and discussions of the matters involved in this suit with Mr. Boyden and Mr. Mann, and I have also had consultations with Mr. Hill, defendants' counsel. During these discussions and consultations there has been a full and free interchange of opinion between all parties, and a practically unanimous conclusion has been reached.

I am unable to say who first suggested or mentioned their
1047 views or opinions concerning the construction of the patent in suit or of the infringement thereof by the defendants. My present recollection is that when I was first requested to examine the patent in suit in connection with Mr. Newbury's deposition and defendants' 1889 and 1891 catalogues, and after having the defendants' triple valves explained to me, I at once reached the conclusion and expressed the opinion that defendants' triple valves involved a mode of operation differing from the patent, and that they did not infringe upon the claims of the patent.

(Answer objected to by counsel for complainant- as not responsive.)

30 X Q. X Q. 29 repeated.

A. I do not know, and the reason is stated in my last preceding answer.

31 X Q. Are the views and opinions expressed by you in chief original with yourself, or were they derived from or based upon information, advice or suggestions to the effect expressed in such views and opinions, from Mr. Boyden or from any other person?

A. I am unable to separate and distinguish my individual views and opinions as distinguished from such as have a basis on information derived from other sources and resulting from my reading, study and discussion of the subject with other parties. The views I have expressed are my views and opinions based upon a careful consideration of the whole subject with all the information I could obtain. Mr. Boyden and myself have entertained substantially the same views on the subject of non-infringement from the first, and

we have been so much in accord that I am unable to distinguish any particular theory or opinion as the property of either.

32 X Q. Coming now to a single instance is the theory as to "momentary differential pressures" presented by you in your deposition original with yourself, or is it derived from a theory to such effect communicated to you by Mr. Boyden or any other
1048 person, or from the reading of a patent or any other source exterior to yourself?

A. I regard it as the law controlling the operation of defendants' valve, and as involved in a correct understanding of said triple valve and its mode of operation. I am unable to state at this time whether, in explaining the operation of the defendants' valve mechanism, Mr. Boyden or Mr. Mann suggested this law, or whether I discovered it upon investigating the subject with a view to ascertain the principle involved in the operation of defendants' quick-action triple valve, as distinguished from the ordinary triple valve, possessing apparently the same number of valves. It is quite possible that either Mr. Boyden or Mr. Mann may have directed my attention to the subject at our first interview, which occurred nearly two years ago.

33 X Q. Upon more careful consideration are you not perfectly sure that the expression "momentary differential pressures" was not original with you, but was coined by somebody else, and that the theory which that expression indicates was not original with you, but was presented to you by somebody else?

A. The expression "momentary differential pressures" was, I think, coined by some one else, suggested to me and adopted as an apt one to describe the principle of operation embodied in defendants' apparatus; but as to the theory of operation, I am unable to say whether or not some one did first suggest it to me, or whether I worked it out for myself.

34 X Q. Referring to your answer to question 2, it is the fact, is it not, that you "participated" in a large number of air-brake tests and experiments conducted or superintended by Mr. George A. Boyden only to the extent of witnessing Mr. Boyden manipulate the handle of an engineers' brake-valve while making experiments upon a testing rack, or elsewhere in the shop?

A. The tests and experiments referred to were made in the shop on different occasions during the past two years. In some of them

Mr. Boyden operated the engineers' valve, and in others some
1049 one else in the shop manipulated the engineers' valve according to instructions given either by Mr. Boyden or myself.

On some occasions the triple valve used was taken off and the interior mechanism examined, and in the last tests made with Exhibits A and B the valves were repeatedly removed from the casing, and, when in operation, the movements of the valves were observed through the glass window in the side of the casing, Mr. Boyden or myself directing an assistant, I don't know who it was, stationed at the engineers' valve, to graduate or produce quick action as desired.

34½ X Q. Your observation of the shop tests at the works of the

Boyden Brake Co. as to which you have testified constitutes the sum total of your practical experience in connection with air brakes, does it not?

A. It does, outside of observations made with respect to the actions of the brake mechanism on running trains supposed to be equipped with quick-action triple valves.

35 X Q. The "observations" referred to in your last preceding answer were, I presume, simply such observations as could be made by yourself or any other traveller when riding in a railroad car, and were not specially conducted observations made in a trip or series of trips?

A. For the most part they were such as *might* be made by most travellers who are much of the time on railway cars, and they also include observations made during the trials of an exhibition train equipped by the Westinghouse Air-brake Co. and exhibited on the railroad at or near Falls Church, Va.

36 X Q. In your answer to question 8 referring to patent 360,070, after describing the operation of the mechanism in applying the brakes by the admission of reservoir air through the port controlled by the graduating valve, you next go on to say:

"When, however, the pressure in train-pipe was suddenly and considerably reduced, either by the engineer, or automatically, by the braking of the train, or the bursting of the train-pipe, the
1050 preponderance of auxiliary reservoir air pressure upon the piston of the triple valve would carry said piston, and the valve connected thereto, its full stroke, and in so doing would drive back the graduating stem and carry the graduating port 31 in main valve beyond the port or passage 23, through which latter, communication was before made with the brake-cylinder, thereby opening communication between the auxiliary reservoir and brake-cylinder through a passage 35 in the end of the main valve."

Doubtless through inadvertence, or possibly under the pressure of a desire to conform to the views expressed by Mr. Boyden, you omitted to mention that the operation described in the foregoing quotation takes place when, and only when, air is admitted directly from the main air pipe to the brake-cylinder through the port governed by the valve 41; or, in other words, when the parts are moved into a position to effect a quick-action application.

What you omitted to state, and what I have stated above, is strictly true, is it not?

A. The description quoted was preceded by a statement that the operations performed "in the *absence* of the new elements and functions added to the triple valve" would be the same as the operation of the triple valve described in patent 220,556. Those operations are referred to in the passage quoted, and are the operation performed by the triple valve proper of patent 220,556. The admission of train-pipe air described in the question is performed by the newly added elements or "additional members" of patent 360,070, and inasmuch as said newly added elements are so connected with the operation of the triple valve proper that the same movement of the piston which brings port 35 into communication with the port or

passage 23 also moves the auxiliary valve 41 to uncover its port 42, it of course follows that if there be sufficient pressure remaining in the train-pipe to unseat the check-valve 49, air from the train-pipe will enter through port 42; but if the air in train-pipe is instantly discharged, no air will enter through port 42, notwithstanding the fact that the valve 41 has been moved to uncover said port.

(Answer objected to by counsel for complainants as not responsive, and as being a volunteered reiteration by the witness of a theory formulated by Mr. Boyden, and not supported by a scintilla of evidence as to what might happen under certain conditions not referred to, even by remote implication, either in question 8 or in cross-question 36.)

37 X Q. X Q. 36 repeated, witness' attention being directed to the fact that he was not asked, either in question 8 or in X Q. 36, what could, or would, or might be the case if the device of patent 360,070 was something different from what it is, and that he is asked simply as to the mechanism as described and shown in said patent, and as to the normal and described operation of such mechanism?

A. I must confess that without the explanation I should not and did not understand X Q. 36 to have reference to any other operation than that described and referred to in the paragraph quoted; and as said paragraph is but part of an answer, I found it necessary to call attention to the statement preceding the explanation given in the quoted paragraph.

If the entire mechanism of patent 360,070 is included, and the conditions under which it is used are such as will retain an effective pressure in train-pipe, after the triple-valve piston is fully retracted, and the passages 35 and 42 opened, train-pipe air will undoubtedly be admitted slightly in advance of the admission of auxiliary reservoir air.

(Same objection.)

38 X Q. X Q. 37 repeated and a categorical answer requested.

A. It is true that I omitted to mention that the operation described in the paragraph quoted in X Q. 36 takes place when and only when air is admitted directly from the main air pipe to the brake-cylinder through the port governed by the valve 41, and it is equally true that the omission was intentional on my part, because that function and operation pertains to the *added mechanism*; and it was not through inadvertence or under the pressure of a desire to conform to the views expressed by Mr. Boyden that I made such omission. What I omitted, and what you have stated in question 36, is undoubtedly a fact when referring "to the mechanism as described and shown in said patent and as to the normal and described operation of such mechanism" under the conditions mentioned in my last preceding answer.

39 X Q. In your answer to question 8 you speak of the operations performed by the device described in patent No. 217,838, July 22, 1879. Do your reading, studies or observations extend far enough

to enable you to know whether the device described in patent 217,838 ever performed any operations whatever or whether such a device was ever constructed?

A. I have no direct personal knowledge of the construction or use of the device described in the patent mentioned, although I have heard that devices similar in their action, and operating to vent the train-pipe at different points for assisting in reducing the pressure in train-pipe, and hastening the serial action of the triple valves, have been employed, but my knowledge on this point is hearsay only.

All of the answer subsequent to the word mentioned as hearsay objected to by counsel for complainant- as hearsay.

40 X Q. Do your reading, studies or observations extend far enough to enable you to venture an opinion as to whether or not the device described in patent No. 217,838, is a practical and workable device or one capable of useful operation in a brake system? Please bear in mind that I am asking about the device as it is and not what it might be changed into in the light of subsequent invention.

Objected to as immaterial, irrelevant and incompetent. The patent in question having been taken out by complainants
1053 and not being involved in this suit, it is hardly competent to discuss its validity in this suit, or for the complainants to deny the operativeness of what they have patented as an operative invention.

Counsel for complainants suggests that the question goes only to the sufficiency of the patent for the purpose for which defendants have lugged it into their testimony.

A. I am of the opinion that a mechanic skilled in the art would be able to construct and use the device described in patent No. 217,838, and to make it work practically for useful operation in a brake system, but whether its operation would be satisfactory in all respects and under all conditions and to all parties I am unable to say.

41 X Q. Do you claim to be a mechanic skilled in this art or in any other branch of the mechanic arts, and do you, as such, enunciate the opinion given in your last preceding answer?

A. I do claim to be something of a mechanic and to have some knowledge of mechanics; but I have not given careful consideration to the proposition, but have relied upon the patent and the statements contained in the patent as true in fact.

Answer objected to by counsel for complainants as not responsive.

42 X Q. X Q. 41 repeated, and a categorical answer requested.

A. My answer to X Q. 40 is not based upon a critical examination of the patent as to the practical and useful qualities of the device, but is based upon the assumption that what the patent states

is true and that Mr. Westinghouse was sufficiently qualified to make the statements found in the patent.

Same objection.

43 X Q. Do you claim to be a mechanic skilled in the art to which patent No. 217,838 relates or in any other branch of the mechanic arts, and if you do, please state the nature and 1054 extent of your mechanical training and experience in whatever art you may claim to be skilled in?

A. My experience has been almost exclusively confined to theoretical mechanics, and has had to do with a great many branches of mechanical arts and has not been specially directed to any particular branch, except as occasion required. I do not claim to be what may be termed a practical mechanic in the art to which patent 217,838 relates.

Same objection.

44 X Q. Could not X Q. 43 have been truthfully answered categorically in the negative?

A. It might with the understanding stated in my last preceding answer.

Same objection.

45 X Q. X Q. 43 repeated, and categorical answer requested.

A. I do. My principal experience and training was in the Patent Office when I had charge of the class of metal-working machinery, and, subsequently, when I had charge of the classes of harvesting and milling machinery.

Objected to as volunteering a statement of the witness' qualifications as a theorist and student which has nothing whatever to do with the operations of a practical mechanic or a skilled mechanic.

46 X Q. Please state for the information of the court the art or arts in which you claim to be a skilled mechanic, the length of your apprenticeship thereto, the manufacturing establishment or establishments in which you have worked, the character of the work you did, kind of tools and machines you worked with and the length of time you spent in acquiring whatever skill you may claim to possess.

This line of cross-examination objected to as simply wasting the time, the witness having already stated the facts fully to the court.

A. So far as actual manual labor is concerned I have never 1055 served an apprenticeship in any manufacturing establishment, nor have I ever worked as a day laborer. I entered the Patent Office when I was 19 years of age and remained there 11 years. During a large portion of this time I was in charge of the class of metal-working machinery; considered, passed upon, allowed or rejected many hundreds, and I may say thousands of applications for patents, all of them involving principles of mechanics as embodied in all kinds of machines for working upon metal from

rolling mills down to pin-making machines, and during this time I made frequent visits to various manufacturing establishments for the purpose of informing myself in mechanical operations and processes. It was a part of my duty to study and understand patents and publications descriptive of mechanical devices and to determine their operativeness.

The same kind of experience I had when in charge of the classes of harvesting and milling, including all harvesting implements from automatic grain-grinders to lawn mowers and scythes, and all the mechanical devices employed in milling.

Subsequently, as examiner of interferences, I was called upon to consider and decide upon questions involving the mechanics of almost every branch of art included in patents.

The Patent Office was the establishment in which I labored and gained most of the information I possess respecting mechanics, mechanical arts, and the construction of patents.

All of the last preceding answers after the word "establishment" in the first sentence thereof, objected to as not responsive and a labored irrelevant argument, the witness not having been asked anything about the work of a day laborer, with which he seems to confound a mechanic, or of a Patent Office examiner, and being only asked as to his qualifications, if any, as a *mechanic*.

47 X Q. You say you never worked as a "day laborer."
1056 Did you ever work as a *mechanic*, if so, where, for how long and in what branch of the mechanic arts?

A. I have not, other than as stated in my last preceding answer.

48 X Q. Please state specifically for the information of the court where in your last preceding answer you have stated that you worked a day or an hour as a *mechanic*.

Objected to as before.

A. I regard much of the labor performed while an examiner in the Patent Office as being the labor of a mechanic; not performed manually with tools and implements, but mentally, with drawings, descriptions and models.

Objected to by counsel for complainants as being merely an irresponsible volunteered argument, wasting time and seeking to avoid a full disclosure of the facts to the court.

Defendants' counsel replies to this objection that the witness has stated the facts over and over again, and that, not content with the facts, complainants' counsel has allowed his cross-examination to degenerate into a mere badgering match, wasting time, to the annoyance of everybody and the advantage of nobody.

Counsel for complainants regrets that a sense of professional duty prevents him from permitting defendants' counsel to conduct both the direct and cross examination of the witness.

49 X Q. Have you received an education in any technical school or college, and if so, in which, and for what period?

A. I have not.

50 X Q. In your answer to question 10 referring to defendants' quick-action triple valve, plate IX, 1889 catalogue, you say :

"To apply the brakes with full power in the shortest possible time, as in making an emergency stop, or in automatically applying the brakes, the pressure of air on the train-pipe side of 1057 the piston is suddenly or entirely reduced, and the piston, under the influence of auxiliary reservoir pressure, will be caused to make its full stroke toward the train-pipe, thereby instantly withdrawing the piston valve 15 from the port 16 and opening a relatively large passage through which air from auxiliary reservoir will flow to the brake-cylinder."

Do you wish the court to understand that at the same time air from the train-pipe will pass to the brake-cylinder, and if you do not, please state whether you find your warrant for the statement I have quoted in the description of the device given in defendants' 1889 catalogue, in patent No. 481,134, with which Mr. Boyden says said valve accords, in information received from Mr. Boyden or any one else, or in any other source exterior to yourself.

A. I wish the court to understand, as plainly stated in my answer to which reference is made in the question, that the operation described in the paragraph quoted will be the operation of the apparatus if the valve chamber is in open and unrestricted communication with the auxiliary reservoir, which fact or condition was intended to be implied and is stated in the paragraph preceding the quotation, wherein I say "omitting from consideration the relative proportions of the several passages, and the separation of the valve chamber, *d*, from the auxiliary reservoir end of the piston chamber, and assuming that a free and full communication was provided between the auxiliary reservoir and valve chamber, so that the pressure of air in said valve chamber would at all times equal that in the auxiliary reservoir." *It was under these conditions* that the action would be as stated in the paragraph quoted in the question.

With the *partition* and *restricted passage* present in the device, train-pipe air would be admitted, as fully explained further on in my answer 10.

(In view of the failure of the witness to adduce evidence of the possession of the qualifications requisite under the law for a 1058 mechanical expert, counsel for complainants declines to cross-examine him as to the merits of the issue in this cause, and here closes the cross-examination.)

JOSEPH B. CHURCH.

10 A. M., WEDNESDAY, *May 24th*, 1893.

Met pursuant to adjournment ; parties present as before.

Redirect examination of Mr. GEORGE A. BOYDEN by LYSANDER HILL, Esq., of counsel for defendants :

(NOTE.—Mr. Boyden's testimony-in-chief begins on page 17 and terminates on page 148.)

R. D. Q. 236. During the taking of the testimony in this case, mention has frequently been made of an application of the brakes

called an "emergency application," or "emergency stop," and also of an application termed the "automatic" application; please explain these terms so that the court can distinguish between them.

Objected to as not proper redirect examination.

A. My understanding of the terms is that *emergency* application means to apply the brakes by venting the main air pipe either at the engineers' valve or by the conductors' valve located in the cars, said operations being performed *manually*, in case it is desired to stop the train as quickly as possible, in cases of emergency.

As to the term "automatic application" of the brakes, my understanding of this term is that it means an application of the brakes *mechanically*; that is to say, in case of the hose connections bursting, or the train separating, the train-pipe would be vented "automatically" instead of by *manual* action, thereby automatically applying the brakes.

R. D. Q. 237. In your cross-examination, the relation of the 1059 port or passage 35, of the patent in suit, to the function of "quick action" was discussed at great length. In order to render such relation clear, assume that, in the triple valve of said patent, No. 360,070, without making any other changes, the port or passage 35 were plugged so as to become incapable of performing any function whatever, and state what would be the practical result.

A. If a quick application of the brakes were made, and the port 35 was plugged up so that no air could pass through it, the result would be to practically destroy the efficiency of the brake in making said quick action, as in such a case only train-pipe air would pass to the brake-cylinder, except what little would pass through the graduating valve while the port 31 quickly passed over the port 23. By such an action, the reservoir air would not be admitted to the brake-cylinder, and in the absence of said reservoir pressure, there would not be sufficient pressure contained in the brake-cylinder to exert a sufficient braking force to quickly stop the train.

R. D. Q. 238. Assuming the train-pipe and auxiliary reservoirs to be charged with the normal working pressure of seventy pounds, and a "quick-action" stop to be then made by suddenly reducing the train-pipe pressure twenty pounds, which of the ports or passages, 42 or 35, of the patent in suit, would as a matter of fact, admit the greater amount of air pressure to the brake-cylinder in making such stop.

A. Undoubtedly the port 35; as the air from the auxiliary reservoir, which passes through the port 35, exerts a pressure of about fifty pounds to the square inch on the piston in the brake-cylinder, whereas the pressure from the train-pipe, which passes through port or passage 42, exerts about ten pounds pressure on the piston in the brake-cylinder, making, in all, about sixty pounds.

R. D. Q. 239. In the specification of patent No. 360,070, page 4, lines 39 to 42 inclusive, I find a statement that the air so taken from the train-pipe will exert a pressure of about twenty-five
1060 pounds in the brake-cylinders; this statement does not ap-

pear to be consistent with the statement in your last answer, and therefore I will ask you to inform the court which of the two statements is substantially correct?

Objected to as not proper redirect examination.

A. My opinion and observation is that when the brake first takes the quick action, if a gauge was placed on the brake-cylinder, it would instantly jump to or register twenty or twenty-five pounds pressure, indicating that there was about 25 pounds pressure passed from the train-pipe to the brake-cylinder at this stage of the operation of the brake; therefore my opinion is that that is what is meant in the patent specification in the lines referred to.

In making an application of the brakes (not a quick-action) the reservoir pressure would exert about fifty pounds on the piston in the brake-cylinder, but when making a *quick* application of the brake there would be about ten pounds more exerted on the piston over that exerted from the auxiliary reservoir pressure alone, making in all about sixty pounds pressure. However, the length of the stroke in the piston in the brake cylinder has considerable to do with the total pressures; the shorter the stroke the greater the pressure exerted and the longer the stroke the less the pressure exerted.

R. D. Q. 210. In your cross-examination, complainants' counsel seemed to question one of your statements, which statement was to the effect that, in the triple valve of patent No. 220,556, if, by the discharge of air from the train-pipe, the triple-valve piston be caused to make a full stroke, as in cases of emergency and automatic application, the main valve H will uncover the port C and permit auxiliary reservoir air to flow freely past the end of said valve, through the port C, into the brake-cylinder. Have you, since your cross-examination was concluded, made any tests or experiments with said triple valve of patent No. 220,556, to prove whether your said statement was correct, or not? If yea, please explain said tests and the results which they demonstrated.

1061 A. Yes, I have taken a Westinghouse triple valve made in substantial accord with patent 220,556, and put a glass side in it and connected the same with the brake-cylinder and auxiliary reservoir and engineers' valve and storage tank, and it operated in accordance with my statement. The operations of the valve were as follows: The whole was charged with seventy pounds pressure and the engineers' valve actuated to discharge a small amount of main air-pipe pressure. This shifted the valve parts and admitted auxiliary reservoir air to the brake-cylinder through the graduating valve. This operation was repeated several times, and each time the graduating valve was opened and admitted a small amount of auxiliary reservoir air into the brake-cylinder. The operation of the graduating valve was observed through the glass window in the side of the valve case.

The whole device was again charged with seventy pounds pressure, and the engineers' valve manipulated to discharge a considerable amount of air from the train-pipe. This instantly shifted the piston in the valve mechanism the full stroke, and the slide-valve

wholly uncovered the port C, thereby quickly and fully applying the reservoir pressure to the brake-cylinder through the said port C. This operation was repeated several times, and each time the performances were alike as stated, the said operation being observed through the glass window in the side of the valve.

In making the last tests, the engineers' valve was manipulated the same as when making an "emergency" application of the brakes.

R. D. Q. 241. Have you here present the Westinghouse triple valve with which you made the tests or experiments described in your last answer?

A. I have; it is now on the table and can be distinguished as having a round disc connected to it by pipe connections, and a glass window in the side of the valve casing.

Defendants' counsel offers said triple valve in evidence, to be marked "Defendants' Exhibit D."

1062 Defendants' counsel states that as the witnesses, Mr. Boyden and Mr. Church, have testified to several experiments and tests, made at the shops of the Boyden Brake Company in Baltimore, on April 25th, 1893, with the exhibits here in evidence, marked "Defendants' Exhibit A" and "Defendants' Exhibit B," respectively, and Mr. Boyden has now testified to further experiments and tests subsequently made by him at the same place with "Defendants' Exhibit D," defendants counsel now tenders and offers to the complainants' counsel a repetition of said tests and experiments, at the same place and under the same conditions as the original tests, if he shall desire to witness them; and requests an intimation from him or his desire in that respect.

Or, if complainants' counsel shall so desire, Mr. Boyden will, at any reasonable time and upon due notice, repeat said tests and experiments in the presence of complainants' counsel and experts.

Counsel for complainants, expressing his appreciation of the courtesy and fairness of the offer made by defendants' counsel, does not deem it necessary, as at present advised, to accept it. If, however, at a later date, he is able to secure the attendance of his expert, and should consider that it would be desirable for the fuller information of the court that these experiments, or any or either of them, should be repeated, he will so advise defendants' counsel, and if an engagement can be made to suit the mutual convenience of the parties, will be glad to attend with his experts for the purpose.

1063 Recross-examination by J. SNOWDEN BELL, Esq., of counsel for complainants:

X Q. 242. Are the statements made in your answers to R. D. Q.'s 237 and 238, statements of your opinions, or do you make them as statements of facts within your knowledge, demonstrated by carefully conducted and recorded experiments or tests?

A. They are statements of my opinions.

G. A. BOYDEN.

Defendants rest. And defendants' counsel gives notice to complainants' counsel that the defendants desire to have this cause got ready for trial at the fall term of this court.

Counsel for complainants replies that he will proceed with testimony in reply as early as is compatible with a careful examination and conference with his experts on the voluminous record presented on behalf of defendants, and with the conduct of such practical tests and experiments as such examination may indicate to be necessary preliminary to the taking of testimony in reply. He also reminds counsel for defendants that complainants' testimony in chief closed on August 19th, 1891.

Defendants' counsel reminds counsel for the complainants that the replication is dated February 28th, 1890, and that the delay of complainants in making out their *prima facie* case, and the delay of the defendants in completing their answering evidence, were about equal, and were acquiesced in by both parties for good and substantial reasons, as counsel supposes. At all events, those delays furnish no reason for delaying the case hereafter, and it is the defendants' desire that it shall be brought to trial as speedily as possible.

1064 Counsel for complainants has not the slightest desire or intention to delay the case, and shall only ask for a sufficient amount of time to enable him to properly prepare and present complainants' testimony in reply.

Defendants' counsel states that he thinks it would, perhaps, be advisable to ask the court to fix the time for closing the evidence in this cause; and therefore he now gives notice to complainants' counsel that on Monday, June 5, 1893, at 10 o'clock a. m., or as soon thereafter as counsel can be heard, at the court-room of the United States circuit court in the city of Baltimore, Maryland, the defendants will make application to his honor, Judge Morris, or such other judge of said court as may then and there be present and acting, to assign a date within which the complainants shall conclude their evidence in reply. In doing this, it is not the intention of defendants' counsel to seek to abridge in any way the reasonable time due to the complainants for concluding their evidence, but merely fix some time within which the evidence may be concluded, so that, if possible, this cause may be tried at the fall term.

Counsel for complainants acknowledges service of the above notice, and will attend at the time and place designated.

1065 & 1066 (Court Order.)

WESTINGHOUSE BRAKE CO.	} Circuit Ct. of United States, Dist. of Md.
vs.	
BOYDEN BRAKE CO.	

Ordered by the court this 5th day of June that the complainants close their testimony in rebuttal on or before December 1, 1893.

THOS. J. MORRIS, Judge.

UNITED STATES OF AMERICA, }
District of Maryland, } To wit:

I, James W. Chew, clerk of the circuit court of the United States for the district of Maryland, do certify the foregoing to be a true copy of the original order, passed on the 5th day of June, 1893, in the above-entitled cause.

In testimony whereof, I hereunto set my hand and [SEAL.] affix the seal of said court this 21st day of June, A. D. 1893.

JAS. W. CHEW, *Clerk.*

1067 United States Circuit Court in the District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WEST-
INGHOUSE AIR BRAKE COMPANY
vs.

BOYDEN POWER BRAKE CO.; GEORGE A.
Boyden, President; Charles B. Mann, Sec-
retary; William Whitridge, Treasurer.

In Equity. No. 321.

I, George Morris Bond, a United States commissioner as afore-
said, before whom the within depositions were taken, do hereby
certify that on the 26th day of April, 1893, and on the various days
adjourned therefrom, ending on the 24th day of May, 1893, I was
attended by counsel of the complainants and defendants in the
above-entitled cause and by the witnesses, George A. Boyden and
Joseph B. Church, and that each witness was by me duly sworn,
and the testimony by him given was then reduced to writing, and
thereafter subscribed by the said witnesses.

And I do further certify that I am not of counsel or attorney for
either of the parties to the said cause, and that I am not interested
in the event of the said cause.

Given under my hand and seal at the city of Baltimore, within
the district of Maryland, this twenty-fourth day
[COM'R'S SEAL.] of May, in the year of our Lord one thousand
eight hundred and ninety-three.

GEORGE MORRIS BOND,
U. S. Commissioner for Maryland.

1068 United States Circuit Court, District of Maryland.

GEORGE WESTINGHOUSE, JR., and WESTINGHOUSE AIR BRAKE COM-
PANY
vs.
BOYDEN POWER BRAKE CO. *et als.*

1. The defendant- respectfully represents to the court that the last
testimony taken by the plaintiffs in this case, which testimony was
taken in rebuttal and with which the plaintiff- closed *its* case, in-
troduced an issue which had not been previously introduced into

the case, and of which the defendant- had no notice when the testimony-in-chief was taken.

2. That for the proper presentation of the case to the court and the proper defence of this case, it is necessary that the defendant- should be permitted to introduce evidence in the nature of rebuttal.

3. That the defendant- is prepared to take such testimony without delay—and that the taking of the same will cause little if any delay in bringing the cause to a hearing—which these defendants are most anxious to do.

4. That the defendants therefore pray the court to pass an order permitting the defendants to take testimony in reply to the testimony of the plaintiffs above referred to, provided reasonable notice of the taking of said testimony be served upon the counsel of the plaintiffs and provided the taking of such testimony be
1069 closed within such time as may be fixed by this honorable court.

And as in duty bound, etc.

SKIPWITH WILMER,

Sol. for Defendants.

Sworn to by George A. Boyden before me this 17th day of March, 1894.

JAS. W. CHEW, *Clerk.*

Ordered by the court this 17th day of March, 1894, that the defendants have leave to take the testimony as prayed in the foregoing petition, provided that at least ten days' notice of such taking be served upon the solicitors of the plaintiff and that the defendants close their testimony finally within thirty days from the date of this order and the testimony so taken be subject to all legal exceptions.

THOMAS J. MORRIS, *Judge.*

UNITED STATES OF AMERICA, } *To wit:*
District of Maryland,

I, James W. Chew, clerk of the circuit court of the United States for the district of Maryland, do certify that the foregoing is a true copy of the petition and order of court thereon now on file among the proceedings in the above-entitled cause.

[SEAL.] In testimony whereof I hereto set my hand and affix the seal of said circuit court his 17th day of March, 1894.

JAS. W. CHEW, *Clerk.*

1070 United States Circuit Court, District of Maryland.

GEORGE WESTINGHOUSE, JR., *et al.* }
vs. } In Equity. No. 321.
BOYDEN POWER BRAKE CO. *et al.* }

And now, to wit: March 27th, 1894, come the complainants, and move the court that the order made by the Honorable Thomas

J. Morris, judge, under date of March 17th, 1894, granting leave to the defendants to take testimony as prayed in their petition, sworn to by George A. Boyden, on the date of said order be vacated.

The following reasons are assigned in support of the motion :

1. That the said order was granted upon an *ex parte* application of the defendants, and without notice to complainants or opportunity for them to be heard in opposition to the petition for said order.

2. That the only material allegation of the petition upon which said order was granted, to wit, that the complainants' testimony in reply "introduced an issue which had not been previously introduced into the case, and of which the defendant had no notice when the testimony-in-chief was taken," is untrue and incorrect, both in law and in fact.

3. That the defendants were represented by counsel throughout the taking of the complainants' testimony in reply, and that said counsel failed to interpose any objection whatever to said testimony on the ground that it introduced a new issue, or an issue of which they had not theretofore had notice, and that they are therefore estopped to now make the allegation that such an issue had been introduced.

1071 4. That the petition on which said order was granted fails to specify or set forth in any manner whatever, the nature, character and extent of the issue which it alleges was introduced, and that the allegation of such introduction is so broad and general, that the order imposes no restriction whatever (except as to time and notice) upon the defendants in the taking of testimony thereunder.

5. That the said order subjects the complainants to undue expense in attending testimony of the defendants which is unwarranted by the complainants' testimony in reply.

6. That the said order makes no provision for the taking of testimony by complainants in reply to such additional testimony as may be taken by defendants under the said order.

GEORGE H. CHRISTY,
J. SNOWDEN BELL,
BERNARD CARTER,

Solicitors for Plaintiffs.

UNITED STATES OF AMERICA, } *set :*
District of Maryland,

J. Snowden Bell, being duly sworn, deposes and says, that he is an attorney and counsellor at law, and of counsel for complainants in the above cause ; that the taking of the complainants' testimony was conducted by him throughout, and that he is familiar with the same, as well as with the testimony of the defendants ; that having full knowledge of the matters set forth in the foregoing motion, the same are true to the best of his knowledge, information and belief.

Sworn to and subscribed before me this 26th day of March, A. D. 1894.

ISAAC BROOKS, JR.

1072 United States Circuit Court, District of Maryland.

GEORGE WESTINGHOUSE, JR., *et al.* }
vs. } In Equity.
 BOYDEN POWER BRAKE CO. *et al.* }

It is this 26th day of March, 1894, ordered by the court that the above motion stand for hearing at 12 o'clock, noon, on Thursday, March 29th, 1894, provided a copy of said motion and of this order be served on one of the solicitors for the defendants, on or before March 27th, 1894.

THOMAS J. MORRIS, *Judge.*

United States Circuit Court, District of Maryland.

GEORGE WESTINGHOUSE, JR., *et al.* }
vs. }
 BOYDEN POWER BRAKE CO. *et al.* }

In explanation of the order of March 17th, 1894, permitting defendants to take surrebuttal testimony it is now, to wit, March 29th, 1894, further ordered that said testimony shall be strictly limited to proof of the operativeness of a device constructed in accordance with the Westinghouse patent, No. 217,838, July 22, 1879, and further that complainants shall have thirty days from the date of closing said surrebuttal testimony to take testimony in reply thereto, and in all other respects the said order of the 17th of March, 1894, remains in force.

(Signed)

THOS. J. MORRIS, *Judge.*

GEORGE WESTINGHOUSE, JR., and WESTINGHOUSE AIR BRAKE CO. }
vs. }
 BOYDEN POWER BRAKE CO. *et als.* }

BALTIMORE, MARYLAND, March 21, 1894.

Mr. J. Snowden Bell, counsel for the Westinghouse Air Brake Company, Pittsburgh, Pennsylvania.

DEAR SIR: You are hereby notified that on Wednesday, April 4, 1894, at 10.30 a. m., at room 544, Equitable building, in the city of Baltimore, and State of Maryland, counsel for defendants will proceed to take testimony on behalf of defendants in the nature of surrebuttal.

The taking of testimony will continue from day to day until complete. You are invited to attend and cross-examine.

Herewith please find a certified copy of the order of the court permitting this testimony to be taken.

Very respectfully,

SKIPWITH WILMER,

Counsel for Defendants.

Service under order as amended March 29th, 1894, acknowledged this 29th day of March, 1894.

J. SNOWDEN BELL,
Of Counsel for Complainants.

1074 United States Circuit Court for the District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WEST-
INGHOUSE AIR BRAKE COMPANY

vs.

BOYDEN POWER BRAKE COMPANY; GEORGE A.
Boyden, President; Charles B. Mann, Secre-
tary, and William Whitridge, Treasurer.

In Equity. No. 321.

In accordance with an order of the court, signed by his honor, Judge Morris, on March 17, 1894, which order was based on a petition of defendants, and a further order dated March 29, 1894, based on a motion made by complainants, and which explained the first order, defendants were given permission to take testimony in the nature of surrebuttal to prove the operativeness of devices constructed in accordance with the Westinghouse patent, No. 217,838, dated July 22nd, 1879.

Deposition- of witnesses and other evidence in surrebuttal on behalf of defendants in the above-entitled cause, taken under the above order as amended, pursuant to notice, before G. Morris Bond, United States commissioner, at the office, No. 544 Equitable building, Baltimore, commencing on Wednesday, April 4, 1894, at 10.30 a. m.

Present, Charles B. Mann, Esq., of counsel for defendants, and J. Snowden Bell, Esq., of counsel for complainants.

1075 GEORGE A. BOYDEN, being recalled, deposes and says in answer to interrogatories propounded to him by Charles B. Mann, Esq., counsel for defendants, as follows, to wit:

243 Q. Are you the same George A. Boyden who has heretofore testified in this cause?

A. I am.

244 Q. Have you read that part of the deposition of complainants' witness, Henry F. Newbury, printed in Complainants' Record on pages 287 and 288 in answer to question 223?

A. I have, and I understand therefrom that Mr. Newbury denies the operativeness and usefulness of the device shown in patent 217,838, dated July 22, 1879, in which I do not agree with Mr. Newbury in any particular.

So much of the foregoing answer as succeeds the words "I have" are objected to by counsel for complainants, as not responsive, and a volunteered statement of the witness.

246 Q. The said question 223 relates to the operativeness of devices constructed in accordance with patent 217,838 of July 22, 1879. I now ask you whether you have taken any steps to test the accuracy or truth of the several statements made by Mr. Newbury denying the operativeness of that device?

Objected to, as irrelevant, immaterial and incompetent under the



pleadings in this cause, which objection is continued without further notice as to the entire line of examination relative to the operativeness of a device constructed in accordance with patent 217,838.

A. I have, and I have carefully considered patent 217,838, and in order to show on what I base my understanding of the operativeness of the device shown in that patent I will quote several paragraphs from the specifications :

1076 First quotation :

"The present device is more especially designed for use with and as a part of brake apparatus of the class commonly represented by the Westinghouse automatic brake, in which the brake power available for immediate use in the brake-cylinders is contained in auxiliary reservoirs, one under each car."

The above quotation refers to what is known as an "automatic air brake," in which the essential elements are, first, a train-pipe; a brake-cylinder, an auxiliary reservoir, and a triple valve. These four elements were old prior to 1879, the same being shown in a drawing I now submit in evidence, and marked "Defendants' Exhibit Drawing of Automatic Brake, 1879." See Fig. 14. This drawing also shows the valve device of patent 217,838, located in the hose coupling and designated by the letter E.

(Here follows diagram marked p. 1077.)

Second quotation :

"It sometimes happens with such brake apparatus, especially in a case of accident, that material advantage could be effected by having all the brakes of the train applied or brought into action simultaneously, or as nearly so as possible. To accomplish this it is only necessary to make provision for the simultaneous opening of one or more ports in the air conduit passages at points not remote from each auxiliary reservoir. For this purpose I arrange at such various parts of the air conduit or communicating pipes as may be desired, but by preference at the couplings, relief valve of the kind shown in the drawings."

This quotation refers to a desirable result that is to be produced in automatic brakes by introducing the new element in addition to the train-pipe; brake-cylinder; auxiliary reservoir; and triple valve which forms the automatic brake as previously used. This new device being a *valve element* to open ports throughout
1079 the train-pipe, and *thereby rapidly deplete the pressure therein to quicken the application of the several brakes throughout the train* in case of accident, or for other purposes.

Third quotation :

"By arranging such valve boxes at several points along the communicating pipe, each section of that pipe becomes relieved from pressure almost immediately on the section in front of it being relieved, and consequently the several sets of brakes throughout the train, are put in action without the loss of time, which would be involved if, for the relief of pressure throughout the pipe, the air

contained in the hinder portions of it had to flow all the way to the escape aperture, which might be near its front part, and is usually on the locomotive."

This quotation refers to the mode of operation, and explains that by relieving each section of train-pipe (a "section" implying a car's length) of its pressure by the new *valve element* placed therein, that the following sections of pipe will be almost immediately relieved of their pressure and *the application of the brakes throughout the train made much quicker than if all the air pressure had to be discharged, by the old method, at the engineers' valve.*

Fourth quotation:

"The same device may be applied at any part of the communicating pipe, *p*, by making therein, across the bore of the pipe, a ported diaphragm, *o*, Fig. 3, such as is used in ordinary stop-cocks, and arranging therein a relief valve of the construction described, as shown in Fig. 3."

This quotation elucidates the fact that the new *valve element* can or may be placed in any part of the train-pipe; and therefore is not confined to any particular location so long as it is suitably arranged therein.

1080 Fifth quotation:

"The form or construction of the relief valve, its function and operation being substantially the same, may be varied considerably, in so far as it is an element in the described combination, without any material departure from the scope of the invention."

This quotation specifies that the *valve element* may be constructed in a variety of ways so long as the function and the operation is retained.

Sixth quotation:

"In the present invention the escape valve enters into combination not only with the brake-cylinder but also with the auxiliary reservoir."

This quotation sets forth that the new *valve element* not only enters into combination with the brake-cylinder but also with the auxiliary reservoir, and as the train-pipe and the triple valve are also essential elements to the brake-cylinder and auxiliary reservoir, they too are in the same combination, making in all five essential elements in the device shown in patent 217,838, four of which are old, and the fifth being the new *valve element*.

The above quotations show conclusively to my mind what the operativeness of the device of patent 217,838, is, and *that the result thereof is to quicken the action of the old automatic brake as used prior to 1879.*

The mode of operation to quicken the action of the automatic brake as disclosed in patent 217,838 of 1879, is the fundamental law which governs all quick-action brakes of today, namely: that of depleting the train-pipe of its pressure "at points not remote from each auxiliary reservoir."

It is true that the patent 360,070 of 1887 in suit, shows other means for executing this fundamental law of the patent 217,838, but nevertheless the operativeness of depleting the train-pipe of its

pressure at points other than the engineers' valve is the essential operating feature of patent 217,838, and of all other quick-acting brakes since that time, including patent in suit, and is therefore the pioneer patent for quickening the action of the several brakes throughout the train.

So much of the foregoing answer as assumes to state "the fundamental law which governs all quick-action brakes of today," and discuss patent 360,970 in suit, objected to by the counsel for complainants, first, as wholly irresponsible, and an unwarranted volunteered statement of the witness, and second as being unwarranted by and wholly at variance with the order of court by and under which this testimony is taken, which order distinctly and in terms specified that this testimony should be limited strictly to proof of the *operativeness* of a device constructed in accordance with patent 217,838.

In order to avoid the delay of an application to the court to restrain further violation of its order by the interjection of testimony wholly foreign to that prescribed in said order, counsel for complainants now and hereby requests counsel for defendants to instruct the witness to refrain and desist from making further irresponsible statements involving matters foreign to that prescribed by said order of court, and gives notice that unless the witness shall desist from so doing he will require the examiner to certify the deposition to the court, and apply to the court for a further order preventing these or other violations of the present order.

Counsel for defendants replies that it is his purpose to take testimony only relevant to the operativeness of devices constructed in accordance with patent No. 217,838, of July 22, 1879. That in order to present this testimony intelligently to the court, it is necessary to show by the witness what is his understanding of the device described in that patent, and how that device operates. Having elicited from the witness what his understanding of that patent is, counsel now proposes to ask him what further steps he took to demonstrate the operativeness of the device in question.

Counsel for defendants states to the witness that his responses to questions put to him should be confined to matters relative to the operativeness of devices constructed according to patent 217,838.

Counsel for complainants replies that the questions heretofore put by counsel for defendants have been entirely proper and fully in accord with the order of the court as is his intention just expressed relating to his further examination. The objection of counsel for complainants was based solely on the irresponsible matter, unwarranted by the court's order, which was interjected by the witness into his answer, and as counsel for complainants now understands counsel for defendants concurs with him in directing that such departure from the limits of the order shall not be hereafter allowed.

Counsel for defendants replies that he suggested to the witness that he should confine his responses to matters relative to the operativeness of the device in question in compliance with the request

made by counsel for complainants that he should do so, and he thus complied in order to have his position on this subject understood and in order to avoid any cavil on the point.

Defendants' counsel offers in evidence the following exhibits, to wit:

A valve device, marked "Defendants' Exhibit Westinghouse Valve, Patent No. 217,838, July 22, 1879."

A section of a valve device marked "Defendants' Exhibit Section Westinghouse Valve, Patent No. 217,838, July 22, 1879."

A valve device marked "Defendants' Exhibit Westinghouse Valve, Patent No. 217,838, July 22, 1879, Attached to Angle Cock."

1085 247 Q. Having stated how you understand patent No. 217,838 of July 22, 1879, I now ask what further steps did you take to ascertain the operativeness of the device shown and described in that patent?

A. I took the patent and after carefully studying it I selected therefrom Fig. 1 (see Fig. 15 this record) as a true representation of the device of the said patent. I then made a working drawing from said Fig. 1 of such proportions that the device I was going to have made could be screwed or attached to the regular hose coupling in use, in order that I might try the device on our testing rack. A copy of the device of patent 217,838 shown in this working drawing I now submit in evidence, marked "Defendants' Exhibit Copy of Working Drawing, Patent 217,838." (See Fig. 16.) This drawing of the device is made exactly like that in the working drawing from which the devices marked "Defendants' Exhibit Westinghouse Patent No. 217,838, July 22, 1879," and section of valve device, marked "Defendants' Exhibit Section of Westinghouse Valve, Patent No. 217,838, July 22, 1879," and also the valves I used to test the operations of the device of said patent, were made.

(Here follows diagram marked p. 1084.)

The counsel for defendants, offers in evidence the two drawings heretofore submitted by the witness, one marked "Defendants' Exhibit Drawing of Automatic Brake, 1879," (Fig. 14,) and the other marked "Defendants' Exhibit Copy of Working Drawing, Patent 217,838, July 22, 1879." (Fig. 16.)

"Defendants' Exhibit Copy of Working Drawing, Patent 217,838, July 22, 1879," objected to as secondary evidence, the original working drawing from which the metal exhibits are alleged to be made being the best evidence, and counsel for complainants calls upon counsel for defendants to produce and offer said original drawing in evidence.

Counsel for defendants states that the original drawing, of which a copy has just been offered in evidence, will be put in evidence.

1086 From the working drawing I had patterns made, and from the patterns had castings made and valves fitted up the same as "Defendants' Exhibit Westinghouse Valve, Patent No.

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217,838, July 22, 1879," and "Defendants' Exhibit Section of Westinghouse Valve, Patent No. 217,838, July 22, 1879," in fact the exhibit marked "Westinghouse Valve" is one which was taken from the rack, and was used in making the tests. These valves are made in strict accordance with the working drawing, and with patent 217,838.

I first made one valve and tried it, and found it to work as set forth in the patent. After this, I made 12 more, and finally made 50, just the same as the one submitted in evidence. These 50 valves were placed in the hose couplings, one to each of the 50 brakes, in a horizontal position, the said position being that in which the coupling hangs in practice.

I then charged the whole apparatus with 70 pounds of air pressure, the amount which is carried in practice. I then graduated the brakes and found that they all graduated in the regular order. I then released the brakes in the regular manner, by admitting air to the train-pipe, and the brakes all released. I then charged the brakes with 70 pounds air pressure again, and applied the brakes for an emergency application, and I found that the valves of patent 217,838, operated as stated in the patent,—they all opened and *quicken the action of the brakes throughout the train*. The time required to apply all the 50 brakes fully, was about eight seconds from the time the engineers' valve was opened until the pressure had equalized in the 50th brake-cylinder and auxiliary reservoir.

I then had all the valve devices of patent 217,838 removed, leaving the 50 brakes in the order that they would be in service when using the plain triple valve. I then charged the brakes with 70 pounds pressure, and applied for an emergency application. The time required to apply all the 50 brakes, without the valve device of patent 217,838, was about 30 seconds, (or nearly four times 1087 as long as when the said devices were used) from the time the engineers' valve was opened until the pressure had equalized in the 50th brake-cylinder and auxiliary reservoir. These tests demonstrated beyond doubt that the valve device of patent 217,838 does operate as set forth in that patent: that the said valve device will *not destroy* the automatic brake, and that the said valve device will *quicken* the action of the automatic brake.

Having made and tested 50 valves like that shown and described in patent 217,838 of 1879, I know that Mr. Newbury is entirely wrong in his conclusions and statements, as the facts are the valves will operate and will produce the results set forth in patent 217,838 of 1879.

The triple valves I used were of the kind known as "plain triple valves," and of a character which will not produce quick action.

248 Q. Do you regard the results you obtained, as to the quickness of action in applying on a train of 50 air brakes, as the best operative results possible to obtain from devices constructed according to patent 217,838?

A. No, I do not. I made the devices in strict accordance with the patent 217,838 in order to shut off cavil as to their being made like the devices shown and described in said patent.

If I was going to design a valve, using the patent as instructing me what the invention was, and using my judgment as to the best form and arrangement, I am satisfied that I could make a device which would be much quicker than the one I did make, as could also any one who was a skilled air-brake mechanic; the patent gives any one the license to use his own judgment, as is shown from the following quotation:

"The form or construction of the relief valve, its function and operation being substantially the same, *may be varied considerably* in so far as it is an element in the described combination, without any material departure from the scope of the invention." (The italics being my own.)

1088 The train-pipe I used, and which our testing rack is equipped with, is one and one-quarter inches in diameter but if this pipe was three-quarters of an inch in diameter the valves I have made, which are in strict accordance with the patent, would be greatly quickened, and the application of the brakes quickened accordingly, as there would in the latter case only be about one third the amount of air to be discharged from the train-pipe, in comparison to the amount which was discharged in using an inch and a quarter pipe.

249 Q. As a skilled mechanic familiar with air brakes, please state what particular position the valve device of patent 217,838 should have in order to get the best operative results contemplated by the patentee?

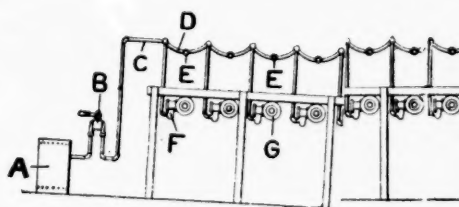
A. I would undoubtedly place it in a position with the escape port C downward, or in the reverse position it is shown in Fig. 1. The reason I would do this is because when the brakes are not in use the valve F would keep the port C closed by the gravity of the piston D, thereby preventing any dust or dirt from getting into the valve when not in use; furthermore, it would then be in position to permit the charging of the brake by supplying the air very slowly, as the piston D and the valve parts would not have to be closed by the air pressure lifting them into position.

250 Q. I will now ask you to state what particular position these valves had as you used them on the test-rack?

A. They were placed in a horizontal position, that is the axes of the pistons D were horizontal, except that of one valve which had the escape port C pointing downward, and which was placed in the key of the angle cock, like "Defendants' Exhibit Westinghouse Valve Patent No. 217,838, July 22, 1879, Attached to Angle Cock." (See Fig. 17 this record.)

(Here follow diagrams marked pp. 1089 & 1090.)

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251 Q. Please briefly describe the test-rack on which you made the tests of a valve constructed according to patent 217,838?

A. The test-rack I used was the one belonging to the 1091 Boyden Brake Company, which is erected at their shop corner of Biddle and Chester streets, Baltimore. The rack contains 50 brakes and piping, just as used in practice; the triple valves used being of that character known as the "plain triple valve;" this rack is equipped with about 1,900 feet of inch and a quarter train-pipe, provided with hose and couplings, and all necessary adjuncts as used in practice. I will now submit a drawing showing the test-rack which was used in making the various tests with the device of patent 217,838. On this drawing (see Fig. 18), the letter A designates the storage reservoir on locomotive; B the engineers' valve; C the train-pipe; D the hose; E the devices of patent 217,838; F the plain triple valves; G the brake-cylinder; H the rack frame; I the angle cock; J the auxiliary reservoirs, and L the pipe-strainers.

Test-racks of this character are now used by the Master Car Builders' committee in testing brakes to ascertain their efficiency as to fulfilling the Master Car Builders' requirements, and therefore are the recognized form for testing brakes.

Counsel for defendants offers in evidence the drawing just referred to by the witness, marked "Defendants' Exhibit Boyden Test-rack." (Fig. 18.)

252 Q. You have stated the triple valves used on the test-rack were "plain triple valves;" please explain more particularly what triple valves they were?

A. The triple valves I used are like the one shown in the Boyden Brake Co.'s catalogue of 1891, with the bushing 9 removed, thereby giving them the capacity and functions of the plain triple valves used in 1879.

253 Q. Who assisted you in the work you did and the tests you made to determine the operativeness of the device of patent 217,838?

A. Mr. L. Gwinn, who superintended the construction of the valves and made the drawing in evidence marked "Defendants' Exhibit Copy of Working Drawing Patent No. 217,838, July 22, 1879," from the working drawing I made.

1092 254 Q. Please look at the exhibit marked "Defend Exhibit Westinghouse Valve Patent No. 217,838, July 1879. Attached to Angle Cock," and explain what the valve is why it is attached to an angle cock?

(Here follow diagrams maked pp. 1093 & 1094.)

A. It is a cut-off cock commonly used on each end of the t pipe of a car; the key thereof is arranged with a ported diaphragm mentioned in the specification of patent 217,838 on line 18, page 1, and shown in Fig. 3 of the drawing, the said figure showing the valve may be attached to the train-pipe other than at the coupling.

This diaphragm in the key of the cock is so arranged that the cock may be used as a cut-off cock as usual, and also to reverse position of the valve device shown in Fig. 3 of patent 217,838 which reversal to insure that the air coming from the engine pass into the device from the proper side, that is through the passage A.

As a skilled air-brake mechanic, I would place the device of patent 217,838 in a cock of this kind for practical railroad purposes, provided the device was made in exact accord with the drawing of patent 217,838.

The reason for placing the valve device in the key of the angle cock as I have just described is, that in case a car should be turned or placed in position in the train so that the air coming from the engine would pass into the valve device through the port B¹, that the valve device could be reversed by turning the handle of the angle cock diametrically opposite to the position it occupied, thereby admit the air from the engine to the valve device through the proper passage A.

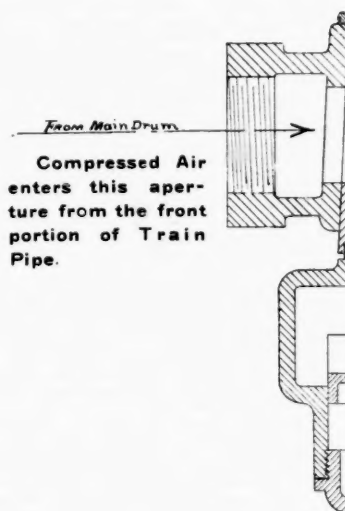
255 Q. Please state whether or not the test you made as to the operativeness of the device of patent 217,838 showed any result such as Mr. Newbury, a witness for complainants, mentions on page 287 of complainants' record, where he states:

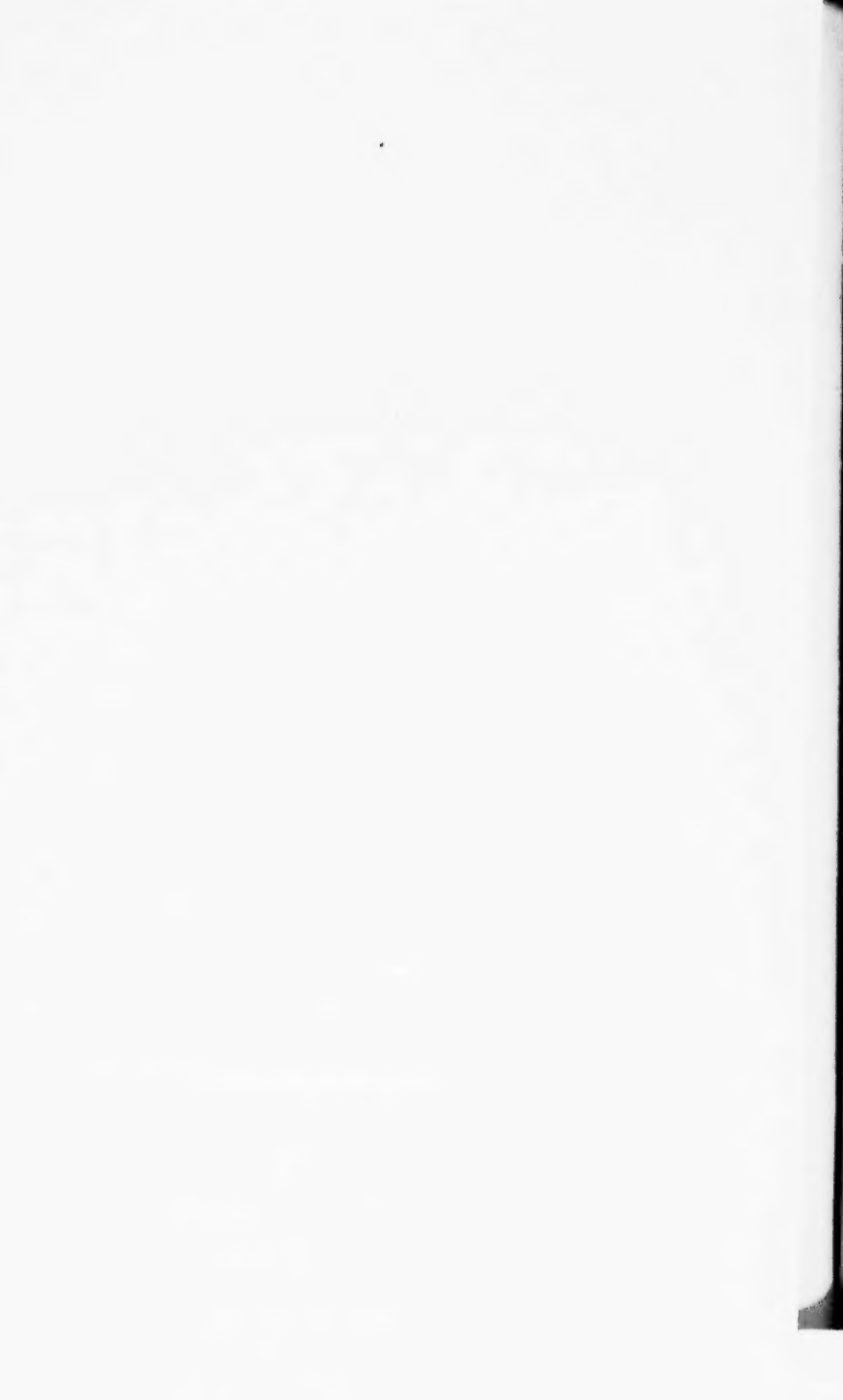
"So far as I can see the device of the patent 217,838 is not adapted at all for practical operations in an automatic air-brake system; in other words, an attempt to incorporate such mechanism into an automatic air-brake system would simply destroy and render it utterly worthless as a system."

1095 A. In the tests I made I did not in any way see or discover why the device of patent 217,838 is not adapted to the automatic brake as explained in that patent, and my experiments proved conclusively that it won't destroy the automatic air-brake system, if incorporated with that brake system.

256 Q. Please state whether or not the tests you made to determine the operativeness of the device of patent 217,838, developed any difficulty such as Mr. Newbury mentions on page 288, where he states:

"The said device is shown in the drawing with its parts in a certain position, and yet there are no means provided for getting

Defendants' Exhibit, Wor**Discharge**



them into that position so as to charge the main air or brake pipe with pressure?"

A. In the drawing the piston D and valve F are shown in the position they occupy when the device is charged with air pressure. If there was no air pressure in the device, the valve parts would drop down from that shown in the drawing, but this is not the position the valve device would occupy in practice. In the tests I made, the axes of the valve pistons were in a horizontal position, and in every instance the valves would close when the air was admitted from the storage tank on the engine. Valves were tried in the position shown in Fig. 1, that is, with the axes of the piston in a vertical plane, and when air was admitted from the reservoir in the usual manner the piston and valves would lift and close the port C.

257 Q. Please state whether or not the tests you made to determine the operativeness of the device of patent 217,838 showed such difficulty as Mr. Newbury mentions on page 288, where he states:

"The very first attempt to apply the brakes would simply relieve the main air or train pipe of all pressure, and render the apparatus worthless as an automatic system of air brakes."

1096 A. No, they did not; when air was admitted to the train-pipe the valves all promptly closed, and the apparatus was not rendered worthless as an automatic system of air brakes; on the contrary, the valves performed the function as stated in patent 217,838, that is, *they quickened the action of the brakes* when the engineers' valve was manipulated in such a manner as to make them operate; therefore, Mr. Newbury's statement is untrue.

258 Q. Please state whether or not the tests you made to determine the operativeness of the device of patent 217,838 showed the difficulty Mr. Newbury mentions on page 288, where he states:

"This description shows that the normal position of piston D and the valve F is the position it dropped into below the shoulder s, thus leaving the port C open to the atmosphere from both sides of the piston. This construction simply renders the mechanism incapable of use, for any practical purposes in connection with an automatic air-brake system?"

A. Mr. Newbury apparently has misconstrued the quotation from the patent, because the position which he terms the "normal position" is the normal position of the piston and valve parts *when the device is acting to discharge the air from the train-pipe to quicken the action of the brake*, but it is *not* the normal position when the train-pipe is charged with air, and the brakes are released. I think Mr. Newbury is entirely wrong in his conclusions about this device in describing the valve F and the port C as being opened when the train-pipe is being charged; the tests I made disclose beyond a doubt that when air was admitted to the train-pipe the valves F closed and prevented any escape of air, nor did they in any way render the automatic air-brake system incapable of use. The tests I made demonstrated beyond doubt that the device shown in patent 217,838 would and did work as described in that patent, and that

said devices would produce useful results—that of quickening the application of the brakes throughout the train.

1097 259 Q. Please state whether or not the tests you made to determine the operativeness of the device of patent 217,838, showed such a difficulty as Mr. Barnes, a witness for complainants, mentions on page 629 at folio 2516:

“Such a device (217,838) so obstructs the feeding or charging process as to prevent its practical application to practical trains?”

A. I do not agree with Mr. Barnes, and the tests I made showed that the device could be used practically; the device does not obstruct the feeding or charging process stated by Mr. Barnes, as I tried it on brakes representing a 50-car train; therefore, Mr. Barnes' statement is untrue, as the brakes did charge when the device was used.

260 Q. Mr. Barnes, in the next paragraph states:

“It would be impossible to graduate the brakes in a service application, so as to make the necessary difference in the force of applying the brakes.”

Please state whether the tests you made developed any difficulty of this kind.

A. No, they did not; when the engineers' valve was manipulated to graduate the brake, as it is used in practice today, the triple valves graduated the brake, that is they applied the brakes with any desired amount of pressure and the valve devices of patent 217,838 did not open, therefore, in this, Mr. Barnes was mistaken.

261 Q. Mr. Barnes, on page 630, also points out a difficulty which he states would be presented in the application of the brakes, and still another difficulty which he thinks would be presented in releasing the brakes, to which I call your attention, and ask you whether the tests you made developed any such difficulties as Mr. Barnes here refers to?

Adjourned to meet tomorrow, April 5th, 1894, at 10.30 a. m.

1098 10.30 A. M., THURSDAY, April 5th, 1894.

Met pursuant to adjournment.

Counsel present as before.

Deposition of G. A. BOYDEN resumed:

A. In answer to that part of your question, and Mr. Barnes' testimony referred to, pertaining to the application of the brake, I would state that Mr. Barnes is mistaken, as I found by actual test that the valve F would not unseat or open the port C when the engineers' valve was placed in the graduating position to partially apply the brakes, therefore Mr. Barnes' statement referred to is untrue. In answer to that part of your question and Mr. Barnes' testimony pertaining to the releasing of the brakes, would say that in the tests I made I found no such difficulty as to releasing the brake; on the contrary, the brakes all released in their proper order; therefore, this statement of Mr. Barnes is untrue.

Fig. 1, Westingh

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262 Q. What have you to say in regard to two relief valves v , v^1 , being represented in Fig. 4 of patent 217,838, as attached on the same hose coupling?

A. As I understand the device, my opinion is that if the valves were placed as shown in Fig. 4, one of them would be inoperative to produce the result which the patent sets forth it is for; that is to say, it would destroy the charging of the brake, and I am satisfied that the valves were shown in this position by mistake, because the air would then enter one valve improperly through the aperture B^1 (see Fig. 1,) which is not the passage for the air to enter the valve device, as shown by the following quotation:

(Here follow diagrams marked pp. 1099 & 1100.)

"When compressed air enters the valve box by the aperture A from the front portion of the communicating pipe, it raises by its pressure the valve E , passes through the hole d , in the piston D , keeps the valve F closed, and passes on by the passage B^1 and aperture B to the hinder part of the pipe to charge the auxiliary reservoirs, in the usual way."

1101 From the above quotation it is obvious that the device of patent 217,838 was intended to be placed in the train-pipe in such position that the air coming from the front portions of the train or the storage tank on the locomotive must enter at aperture A and pass out at aperture B^1 . This would not be the case if two valves v and v^1 were arranged as shown in Fig. 4, as one of the two would be in a wrong position to receive the air through aperture A .

263 Q. I have questioned you relative to Mr. Newbury's and Mr. Barnes' testimony touching their views of the operativeness of the devices constructed in accordance with patent 217,838 of July 22, 1879. I do not remember that either of the other witnesses for complainants made reference to this patent. As you are more or less familiar with the testimony of all of complainants' witnesses, I now ask you whether you have any recollection of either of the other witnesses commenting upon this patent?

A. I have no recollection of any other of the complainants' witnesses testifying as to patent 217,838; however, in case they did, and their testimony was of the same character as either Mr. Newbury or Mr. Barnes, I should deny the same in the manner I have the testimony of Mr. Barnes and Mr. Newbury.

264 Q. Can you produce the original working drawing which you made of the device shown in patent 217,838, and to which you referred in your answer to question 247?

A. I can; this is the drawing. I would explain that the device shown in the original working drawing is arranged on or attached to the key of the angle cock which goes on the train-pipe. The valve device can be unscrewed from this key and screwed or attached to the hose coupling, being equally well adapted to be attached to either the hose coupling or the key of the cock. I also produce a tracing of the working drawing, showing a handle to reverse the

1102 position of the key when desired; this handle is not shown on the working drawing, although thereon there is a centre line which indicates its position.

Counsel for defendants offers in evidence the original drawing referred to by the witness, which is marked "Defendants' Exhibit Working Drawing, Patent 217,838, on Angle Cock" (see Fig. 17); also the tracing referred to by the witness, marked "Defendants' Exhibit Tracing of Working Drawing, Patent 217,838, on Angle Cock."

(Here follows diagram marked p. 1103.)

Cross-examination *de bene esse* by J. SNOWDEN BELL, Esq., of counsel for complainants, reserving objections taken :

X 264 Q. You say that the devices which you tested to prove the operativeness of a device constructed in accordance with patent 217,838 were made "in strict accordance with the patent 217,838." In the tests which you made were they applied to and connected with the other members of an automatic brake system in strict accordance with patent 217,838?

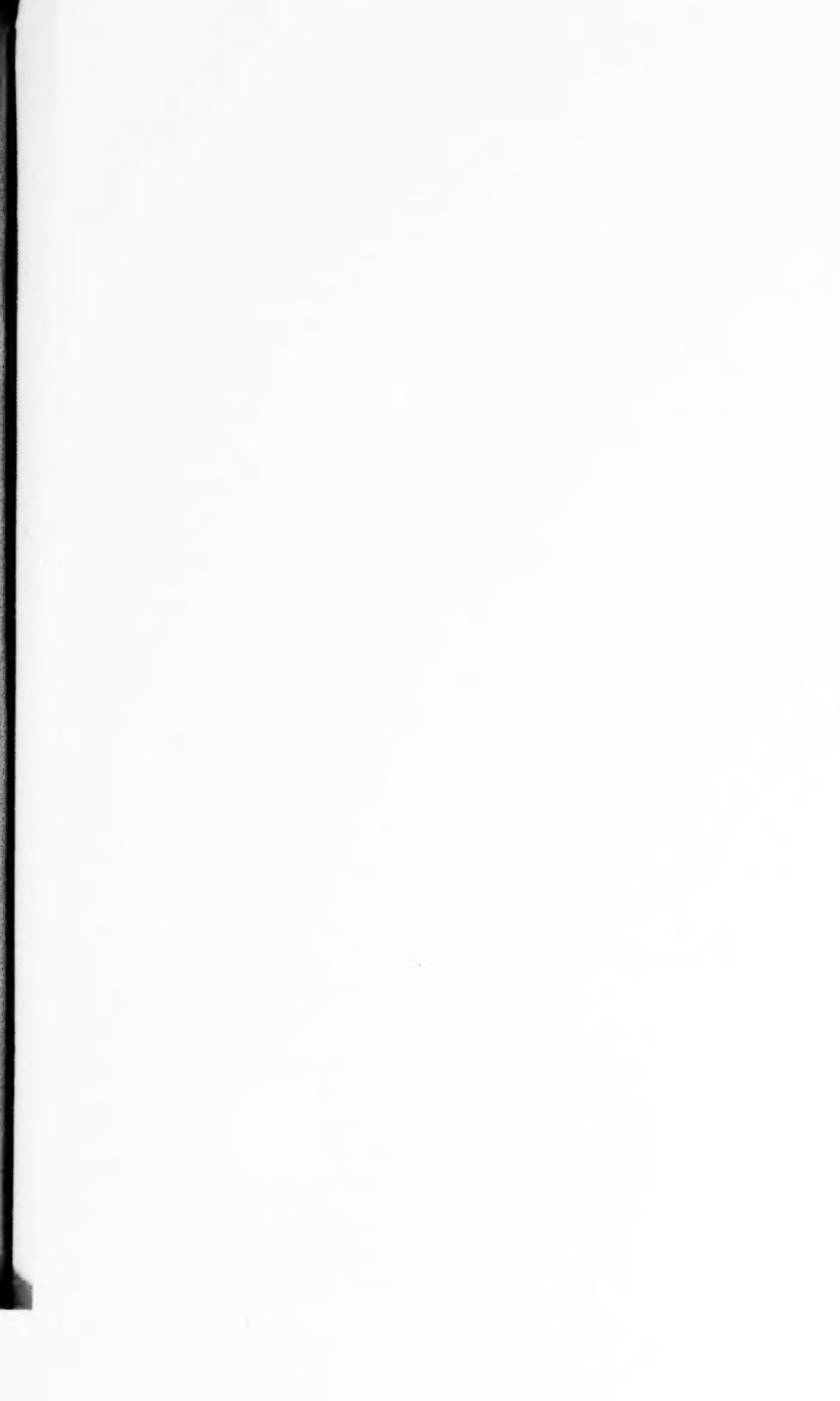
A. They were, as I understand the patent 217,838.

265 X Q. There are two different applications of the device illustrated in patent 217,838, in one of which it is connected with the sections of a two-part hose coupling, and in the other it is applied at a point in the length of a train-pipe having a ported diaphragm; with which of these applications did your experiments accord, or did they accord with both of them?

A. They accorded with both of them—that is to say, 49 of the 50 devices were attached each to one section of a hose coupling, as shown in Fig. 1 of patent, and one of the 50 was arranged in the key of the angle cock, substantially in the manner as shown in Fig. 3—that is to say, the key of the angle cock was provided with a diaphragm O, and the device of patent 217,838 secured to the key, substantially in the manner as shown in Fig. 3.

266 X Q. Was each half section of the several hose couplings provided with one of these devices in accordance with the statement of the patent that "I (the patentee) arrange at such various parts of the air conduit, but by preference at the couplings, relief valves of the kind shown in the drawings," and in accordance with Fig. 4 of the drawings of patent 217,838?

A. As I understand the quotation you refer to, it does not mean that every half section of the hose couplings of the train should be provided with these devices; therefore when I attached the devices of patent 217,838 to the couplings, I arranged one device to each two sections which make one hose coupling, and placed the device in that section which would admit the air from the main reservoir into the device through the aperture A. I did not arrange them as shown in Fig. 4, because if arranged in the manner therein shown, one of the devices would be inoperative, as stated in my testimony-in-chief.



267 X Q. Then as a matter of fact, so far as your application of the device to hose couplings was concerned, such application was *not* in accordance with the only illustration given in the drawings of the application of the device in connection with other members in an automatic brake system, to wit, that shown in Fig. 4, and differed therefrom in the particular that while said Fig. 4 shows the valve device as connected to each half section of the couplings, you only connected it to one of the half sections. This is correct, is it not?

A. So far as concerns Fig. 4, it is correct, but I consider the manner I attached the device to the couplings to be in accordance with the patent, especially so owing to the following quotation:

"The same device *may be applied at any part* of the communicating pipes, *p*, by making therein, across the bore of the pipe, a ported diaphragm O, Fig. 3."

In the arrangement of the device shown in Fig. 3, but one valve device is used, which clearly indicates but one is to be used on each car; therefore, I think I am in strict accordance with the patent in using one device to each two sections of the hose couplings.

1106 All of the last preceding answer, succeeding the word "correct," objected to as not responsive, and a volunteered argument of the witness.

268 X Q. Did you or did you not apply the devices to the couplings in accordance with Fig. 4 of the drawings of patent 217,838, and is not said Fig. 4 the only figure of said drawings in which the devices are shown in connection with a train-pipe, triple valve, auxiliary reservoir and brake-cylinder of an automatic brake system?

A. Pertaining to the first part of your question I did not apply two of the devices to each of the hose couplings as shown in Fig. 4, as I used common sense, and applied the devices to the train-pipe in such manner that they *would* work, and not in a manner that they would *not* work. As to the second part of your question, Fig. 4 is the only figure of the said drawing in which the devices are shown in connection with a train-pipe, *triple valve, auxiliary reservoir and brake-cylinder*.

269 X Q. You also say that one of the 50 valve devices of patent 217,838 which you used, was arranged substantially as shown in Fig. 3 of that patent. Does Fig. 3 show the valve device in or in connection with the key of an angle cock?

A. No, it does not, but it shows it arranged with a ported diaphragm in the pipe, and as arranged in the key of the angle cock it is there also placed in connection with a ported diaphragm.

All of the answer succeeding the word "not" objected to as not responsive, and a volunteered statement.

270 X Q. Does the description of Fig. 3 given in the specification of patent 217,838, state that the valve device is to be used in or in connection with the key of an angle cock?

A. It does not.

271 X Q. Does the specification of patent 217,838, *anywhere* state that the valve device of said patent is to be used in or connected to the key of an angle cock?

A. It does not, so far as I know.

1107 272 X Q. When applying the valve devices of patent 217,838 in accordance with what you understood and understand to be their intended application when attached to hose couplings, you were particularly careful, were you not, to attach them so that they would be on the front coupling section of a train-pipe of each car represented on the rack, that is to say, the section nearest the main air reservoir on the engine?

A. I was.

273 X Q. Do you find any indication in the drawings or instruction in the specification of patent 217,838 that in the application of valve device of said patent to an automatic brake system, it must be placed upon such coupling section, and only upon such coupling section as specified in the last question and answer?

A. The specification states as follows:

"When compressed air enters the valve box by the aperture A from the front portion of the communication pipe, it raises by its pressure the valve E, passes through the holes *d* in the piston D, keeps the valve F closed, and passes out by the passage B¹ and aperture B to the hinder portion as the pipe to charge the auxiliary reservoir, in the usual way."

From this description of the operation it is plain that the valve device must be applied to the train-pipe in such a manner that the compressed air from the storage tank or main reservoir must pass into the device by way of aperture A. From this quotation any one skilled in air brakes, in placing the device in the train-pipe, would arrange it in such a manner that it would operate as set forth in the specification.

I do not find any direct statement in the specification as set forth in your question.

274 X Q. Then as a matter of fact, and regardless of your inferences and conclusions, the specification of patent 217,838 does *not* contain any instruction or direction that the valve devices must be arranged relatively to the main air reservoir in the manner in which you arrange them; this is true, is it not?

1108 A. I do not find any passage in the specification that states that they *must* be placed as I arranged them in making the test, although the specification states:

"The form or construction of the relief valve, its function and operation being substantially retained, may be varied considerably, in so far as it is an element in the described combination, without any material departure from the scope of the invention."

This quotation gives great latitude to the skilled mechanic in the construction or form of the valve, and I think it also gives the skilled mechanic considerable scope for his judgment as to how or where the device would be arranged, so long as the described combination was maintained.

Objection to as not responsive, and an unwarranted and unasked-for statement of the witness, and counsel for complainants protests against and asks the attention of the court to the waste of time caused by the witness in formulating and enunciating arguments in response to questions of fact.

275 X Q. Could not the last preceding question have been truthfully answered by the single word "yes?"

A. It could have, but I think it my duty to the court to point out those parts of the specification wherein it states anything of a nature giving license to a skilled mechanic to use his judgment as to the construction or arrangement of the valve.

In further looking over specification I find the following (page 1, column 2, second paragraph):

"The aperture A of the valve box is seated in the lateral port opening of the *coupling R*, so as to come in the *line* of the *flow* of air through the brake-pipe, hose, and couplings." (The italics are my own.)

This quotation would also indicate that the valves are to be placed in the couplings as I placed them.

Objection and protest continued.

1109 276 X Q. Suggesting to you that your duty to the court will be better complied with if you will refrain from volunteering arguments in reply to questions of fact, and noting that you seem to object to my use of the word "must," I now ask you whether it is not true, as a matter of fact, and regardless of your inferences and conclusions, that the specification of patent 217,838, does *not* contain any instruction or direction whatever that the valve devices are to be located relatively to the main air reservoir in the manner in which you located them. This question calls for and fairly admits of a specific answer, and I will be obliged if you will give one?

A. The specification does not specify how the valve should be placed in relation to the *main air reservoir*, but it certainly does state that the aperture A must be placed so as to come in line of the flow of air through the brake-pipes leading from the main air reservoir, and I think I am justified in stating that the specification plainly implies how the aperture A of the valves are to be placed in the couplings R in reference to the flow of the air through the pipes as set forth in the last preceding quotation.

Objection and protest continued as to all of the answer succeeding the word "reservoir."

277 X Q. Could not cross-question 276 have been truthfully answered in the affirmative?

A. It could not, as I stated in my preceding answer there are instructions in the patent which direct how the valve should be located in regard to the direction in which the air passes through.

278 X Q. Then if X Q. 276 could *not* have been truthfully answered in the affirmative, please quote from patent 217,838 whatever you may choose to call an instruction or direction that the valve

devices are to be located relatively to the main air reservoir in the manner in which you located them?

A. I will quote the following (page 1, column 2, paragraphs 2 and 3):

1110 "The aperture A of the valve box is seated in the lateral port opening of the coupling R, so as to come in the line of the flow of air through the brake-pipe, hose, and couplings."

"The aperture A communicates with the port of the next *half coupling*, and the aperture B leads to the hose and brake-pipe." (The italics are my own.)

From these quotations it is perfectly plain to me, as a skilled air-brake mechanic, and I think would be to any other skilled air-brake mechanic, how to place the relative position of the aperture A in relation to the flow of the air through the train-pipe.

In the last paragraph of the two quoted, it states that the aperture A communicates with the port of the next half coupling, and this is the exact manner in which I had the aperture A of the valve device of patent 217,838 placed in making the tests referred to in my deposition-in-chief.

279 X Q. Do you desire the court to understand that you believe that the quotation made in your last preceding answer is an instruction or direction of the specification of patent 217,838, that the valve devices are to be located relatively to the main air reservoir in the manner in which you located them?

A. I certainly do.

280 X Q. Would not the aperture A "come in the line of the flow of air through the brake-pipe, hose, and couplings," just exactly as much if the valve devices had been located so that the ports B¹ were nearer the main air reservoir than the aperture A, as if they had been located in the manner in which you located them?

A. No, that is not the manner in which I would interpret the meaning of the second paragraph, column 2, page 1.

281 X Q. Would not the aperture A communicate with the port of the next half coupling just as fully if the valve devices had been located with the ports B¹ nearer the main air reservoir than the apertures A, as they would do if they had been located as you located them?

A. That is not the interpretation I would put on the paragraph.

If the two paragraphs were to be interpreted in such a manner as to place the apertures, B, nearest the engine, such an interpretation and location would make the valve device inoperative, and I consider that the common-sense view as to the manner in which the paragraphs are to be interpreted, is that manner in which the valve devices will be operative.

Objected to as not responsive

282 X Q. I did not ask you anything about your "interpretation" of the specification, or of any "paragraph" in it, but *did* ask you a plain question of mechanical fact, wholly separate and apart from the specification. With this explanation I repeat cross-question 281.

A. Literally speaking, I think they would, but when taken as the devices are to be used, and in connection with the elements they are to be used with, I don't think they would, and I base my opinion on the fact that in one way the valve device 217,838 *would be operative*, whereas in the other way they would *not* be operative, and it seems obvious that *the proper way to place them* is the way in which the valve devices would be operative.

283 X Q. I did not ask you anything about the proper way to place the valve devices, and only asked you as to the communication of the aperture A with the port of the next half coupling. In order that you may put yourself clearly on record on this point, I will now ask you to state as a matter of mechanical fact for the information of the court whether the aperture A would not communicate just as fully with the port of the next half coupling if the valve devices were located with the ports B' nearer the reservoir than the aperture A, as they would do if they had been located as you located them?

1112 A. I have stated that they would, literally speaking, but in operation of the device with the other parts it is evident that they are to be located so that the air will pass from the main air reservoir into the device in the proper manner.

284 X Q. You say that they would "literally speaking;" would they not absolutely and unqualifiedly?

A. They would, if nothing else is to be considered in the matter; that is to say, if you just couple up two sections of coupling they would certainly be in communication if the air was admitted from either direction; but this is not the manner in which they are to be coupled when the device is to be in operation in connection with the automatic brake.

285 X Q. The aperture A would communicate just as fully, and communicate no more or no less, with the port of the next half coupling if the devices were coupled in the way in which you think they ought to be, as they would if the devices were coupled in the way in which you think they ought not to be. Is not this undoubtedly the case, as a matter of mechanical fact?

A. I have endeavored to answer the questions pertaining to the subject under discussion in a truthful manner, and in the manner that they should be answered in the light of the description of the device as set forth in the patent; they are the best answers I can give, and as I have, I think, fully answered them I think it would be useless for me to try to answer any more fully, nor can I do so.

The answer is objected to, as not in the slightest degree responsive.

286 X Q. I have not intimated a doubt of your truthfulness in your deposition, and have objected only to your substituting arguments for statements of fact when asked for. As X Q. 285 is a simple question of mechanical fact which it would be absurd to suppose that one having your mechanical qualifications is unable to answer, I shall have to repeat it, and ask you to give a categorical answer?

1113 A. I did answer it substantially in my preceding answer, in which I stated that *they would*, if the couplings were to be coupled together and nothing else considered except as to the aperture A being in communication with the port of the next half coupling.

287 X Q. Would the aperture A be any more or any less in the line of the flow of air through the brake-pipe, hose and couplings, if the devices were located relatively to the main air reservoir, in what you believe to be the proper and operative way of locating them, than if they were located in what you believe to be the improper and inoperative way of locating them?

A. I should say that in the one case they would be in the proper form of the line of the flow of air, and in the other case they would be in an improper form of the flow of air. It is true that in both positions they would be "in the line of the flow of air," but in one case the line of valve devices would be operative and in the other they would not, and I think the quotation from the patent, pertaining to the aperture A being in communication with the port of the next half coupling, undoubtedly conveys the meaning that the aperture A should be arranged as I have stated.

288 X Q. Can you not give a specific answer to X Q. 287?

A. I think I have given a specific answer when I stated that they would not be any more or less in the line of communication,—if you mean that the devices are to be just coupled together without reference to the operativeness of the devices.

289 X Q. In view of the arguments which you have made in your cross-examination, and of the manner in which you located the valve devices of patent 217,838 relatively to the main reservoir in your tests, I presume you will unhesitatingly admit that if said devices were so located in a train line that the passages B¹ would be nearest the main reservoir, so that the passage of air in the train line would be from left to right in the drawing, said devices would not only be wholly inoperative for the purpose provided in
1114 the patent, but would also be fully operative to absolutely destroy the effectiveness and operativeness of the entire brake system. Will you make this admission?

A. My understanding of the device shown in patent 217,838, is, if put in the train-pipe line with the aperture B towards the end so that the air in its passage from the main drum would first pass through the aperture B, instead of A, this air would act on the piston D so as to open the port C and prevent the brakes from being charged, and in this sense, it would destroy the operativeness of the automatic brake; but no skilled mechanic in air-brake practice would apply the devices of patent 217,838 in such a manner; on the contrary, he would apply it in a manner to make the device operative, and in such a way as to admit the air from the main reservoir, first through the aperture A as it passed to the device of the said patent. I think a man would be utterly devoid of sense to place a device in relative position to other parts in such a manner that it would be inoperative, whereas by use of common judgment he could arrange it so it would be operative, as I have done.

Answer objected to, as not responsive, and embodying a volunteered argument of the witness.

290 X Q. Will you, or will you not, unqualifiedly admit that if the devices of patent 217,838 were so located in a train line, that the passages B¹ would be nearest the main reservoir, so that the passage of air in the train line would be from left to right in the drawing, said devices would not only be wholly inoperative for the purpose provided in the patent, but would also be fully operative to absolutely destroy the effectiveness and operativeness of the entire brake system?

A. I will, and I did so admit in my preceding answer, when I stated "it would destroy the operativeness of the automatic brake."

Adjourned to meet tomorrow April 6, 1894, at 10 o'clock a. m.

FRIDAY, April 6, 1894.

Met pursuant to adjournment.

Present: Counsel as before.

1115 Cross-examination of Mr. G. A. BOYDEN resumed:

291 X Q. It therefore necessarily follows, does it not, that it would be mechanically impossible for the devices of patent 217,838 to be operative in an automatic air-brake system, unless each of these devices was so located in the line of train-pipe relatively to the main air reservoir, that the aperture A would be nearer the main reservoir than the passage B¹, or, in other words, the aperture A would always be nearest the front of the car?

A. My understanding of the operation of the device is that the aperture A must be located so as to receive the air from the main air reservoir on the engine, and if it is placed in the position with the aperture B towards the engine, then the device would be inoperative.

292 X Q. The statement which I made in X Q. 291 is then entirely correct, is it not?

A. I consider that it is, but in order that my answer should not be misconstrued in any way, I made the explanation set forth in my preceding answer.

293 X Q. Do you think there is any risk of being misconstrued in admitting unqualifiedly the correctness of the statement, when you consider it to be true, and have no reason to qualify it in any particular?

A. No, I do not, provided my answer is always connected with the question.

294 X Q. You will also unqualifiedly admit, will you not, that if a half coupling on the train-pipe of a car having attached one of the devices of patent 217,838 was connected to the half coupling of an adjacent car, also having one of these devices attached, as indicated in Fig. 4 of patent 217,838, said devices would not only be wholly inoperative for the purposes provided in the patent, but would be operative to absolutely destroy the effectiveness and operativeness of the entire brake system?

A. I will admit that such is the case, when the devices are
1116 placed in the positions you have referred to in your question,
and I have so testified in my deposition-in-chief, in answer
to question 262.

295 X Q. You will also unqualifiedly admit, will you not, that if
the train-pipe of a railroad car was fitted with one of the devices of
patent 217,838, it would be necessary to turn the car after each run,
in order that the aperture A should always be in advance or towards
the engine?

A. I will admit that such would be the case, that is to say, if
there is no other means provided, the car would have to be turned
around, so that the aperture A would be in position to receive the
air from the main reservoir on the engine.

296 X Q. As a skilled air-brake constructor and president of the
corporation defendant, is it your opinion that this or any other de-
vice which required that a car would have to be turned after every
run, in order that its air-brake apparatus should be operative when
moving in the opposite direction, would be a usefully operative de-
vice in an automatic air brake system, or would be accepted as such
by any sane railroad man?

A. As a skilled air-brake constructor, my opinion is that this
device or any other that would require the car to be turned around
before the device could be used, would not be practicable at all in
railroad service; and further, I don't think any sane railroad man
would apply a device that would require a car to be turned before
the device could be operative; and, I also consider, as a skilled air-
brake constructor, I would be insane to apply such a device, or any
device to a car that would not be operative, but as a skilled air-
brake mechanic I would apply the device to the car in such a way
that it would be operative, and I have shown one way wherein I
have located the device of patent 217,838 in the key of the cut-off
cock, by which the device would be made operative without revers-
ing the position of the car.

The latter portion of the answer, commencing with the
1117 word "but" objected to as not in the slightest degree re-
sponsive, and a volunteered statement.

297 X Q. I am not asking you anything about what you or any-
body else might invent to overcome the obvious practical inopera-
tiveness of the device of patent 217,838, and my question was
simply directed to that device as described and shown in that pat-
ent, and not to some other or different construction. Am I or not
correct in understanding you to admit that you do not consider the
device described and shown in patent 217,838 to be a usefully op-
erative one in an automatic air-brake system, by reason of the fact
that with such device the car must be turned after each run, in order
to enable its brake apparatus to be operative at all when running in
the opposite direction?

A. You are correct in understanding me to admit that the device
shown in patent 217,838 to be operative must admit the air to the
valve device through the aperture A, and if it was placed in a posi-

tion that this would not be the case, the device would be inoperative. I think, from the following quotation from the patent, that it is obvious that the inventor intended the device to be put in the train-pipe in a certain way, that is to say, with the aperture A in a position to receive the air from the storage reservoir on the locomotive. The quotation is as follows (page 1, column 2, 4th paragraph):

"When compressed air enters the valve box by the aperture A from the *front portion of the communicating pipe, &c., &c.*" (The italics are my own.)

Answer objected to as not in the least degree responsive.

297 X Q. repeated.

A. You are correct in understanding me to admit that the device as shown in the patent would be inoperative by reason of the fact that the car would have to be turned around to make the device operative, provided the car was not in the proper position to receive the air, that is to pass the air into the device through the aperture A.

298 X Q. If the car was in proper position for the device to be operative when moving in one direction, it would necessarily be in position for the device to be inoperative and destroy the effectiveness of the brake system when running in the opposite direction, would it not?

A. It would, if the air from the engine was also coming from the opposite direction.

299 X Q. I mean of course that in each direction of motion the engine was placed at the head of the train, as is usual in running a train. With this explanation, you would answer X Q. 298 unqualifiedly in the affirmative, would you not?

A. I would.

300 X Q. Coming now to this novel angle-cock device which you have presented, and which I understand you to admit is not shown in the drawing or described in the specification of patent 217,838. From your knowledge as an expert of the state of the art, was an angle cock having a ported diaphragm in its key ever known or used prior to its being devised by you in the construction which you have here presented?

A. My opinion is no such cock was ever used or devised before.

301 X Q. Such a device then was not, in your opinion, known in the art at the date of the patent 217,838?

A. So far as I know, it was not.

302 X Q. Was a valve device similar to that of patent 217,838, connected to the key of an angle cock and having its aperture A communicating with a port in a diaphragm in said key as, or substantially as, in the angle-cock construction here presented by you, known in the art at the date of the patent 217,838?

A. It was not, so far as I understand.

303 X Q. Such a device or construction as is recited in the last preceding question would attain the new and useful result of over-

coming, in your opinion, the practical inoperativeness of the
1119 device described and shown in patent 217,838 due to the fact
that with the device described and shown in patent 217,838
it is necessary to turn the car whenever its direction of motion is to
be reversed. This is the fact, is it not?

A. It would.

304 X Q. In view of your familiarity with letters patent, and
your experience as a solicitor of patents, testified to in your original
deposition, please state whether or not, by reason of the novelty and
utility of the angle-cock construction, recited in X Q. 302, and
presented by you, said construction would involve invention, and
be entitled to the protection of letters patent?

A. My opinion is that it might be.

305 X Q. It is a fact, is it not, that long prior to the institution of
this suit, you yourself recognized the obvious practical inoperative-
ness of the device of patent 217,838, and invented and patented
another appliance of that character with a view to obviating such
inoperativeness; such invention being the subject of your letters
patent No. 404,768, dated June 4th, 1889?

A. It is, and I also designed and used valve devices substantially
like that of the patent 217,838, that is to say, a device having a port
and valve mechanism to discharge the air from the train-pipe at
each car, to quicken the consecutive action of the brakes which did
not require a cock to reverse it, as they did not require reversal.
These valves I applied to a train, which was tried on the B. & O.
railroad, and worked entirely satisfactory; for this latter valve I
do not remember of ever applying for a patent.

306 X Q. In making the valve devices similar to those of patent
217,838, with which you experimented, on what scale did you make
them, relatively to the drawing of the patent. I mean of course
the devices with which you made the test referred to in your depo-
sition-in-chief.

A. About twice as large, that is to say, I could not follow the
exact relative scale in the patent 217,838 of the device shown in
Fig. 1.

1120 307 X Q. Is it not a fact that the springs in these devices
which correspond with the springs *e*, of patent 217,838, are
not of as great dimensions as those shown in the patent, that is
to say, that they are not increased proportionately to those of the
patent?

A. I cannot answer that question, because there is no means to
ascertain the tension of the spring *e* in the patent.

308 X Q. And you do not therefore know what tension should be
exerted by these springs to be in proper accordance with the patent,
do you?

A. They should exert enough tension to just keep the valve E
seated, or in its relative position as shown in Fig. 1.

309 X Q. All the tests which you made with these devices were
made on the rack at your works, were they not?

A. They were.

310 X Q. How many tests did you make, and when?

A. I made various tests, commencing with one valve, then 12, then 25, then 50. It would be impossible for me to state how many times I tried them. They were made since the first of this year.

311 X Q. Were you assisted in these tests by anybody else but Mr. Gwinn?

A. No; of course the workmen were present, who would do the manual work under instructions from Mr. Gwinn or me.

312 X Q. Did you make any record of the results of these tests, and if so, can you produce them?

A. No, I made no record of the tests.

313 X Q. The record shows that in your answer to Q. 247, you originally said: "I then graduated the brakes and found that they graduated the same as though the new valve element were not employed." You afterwards amended this answer by cancelling the words "the same as though the new valve element were not employed," so that the matter as originally stated by you now reads: "I then graduated the brakes and found that they all graduated in the regular order."

1121 Did you find that they graduated "the same as though the new valve element were not employed," and if not, what difference in graduation did you observe?

A. The reason I changed the wording of the sentence you refer to was, that I did not try how the brakes graduated without the device, therefore the manner in which I first stated it was not correct, as I did not try the brakes in the graduation application without the valve devices of patent 217,838.

314 X Q. Then as a matter of fact you do not know and cannot say whether or not, when using these new valve elements of patent 217,838, the brakes graduated "the same as though the new valve element were not employed?"

A. I cannot say. What I wished to ascertain was, could the brakes be graduated without producing a quick action, and not as to the *degree of proficiency* of the graduating application.

315 X Q. Is it not the fact that in every application of the brakes which you made the valves F opened and released air from the train-pipe at points adjacent to the respective triple valves?

A. No, it is not a fact. The valves did not open when the graduation application was made, but did open when a *quick* application of the brakes was made.

316 X Q. If the valves F did not open when a graduation was made, how were you able to effect a reduction of train-pipe pressure in that part of the train-pipe in rear of the first appliance in which the valve F did not open?

A. Owing to the fact that the pistons D are about one sixty-fourth of an inch smaller in diameter than the bore of the cylinder in which the piston-D move. In making the graduation application of the brakes, the air from the rear portion of the train passes to the front portion by passing around the piston, D, or through the space between the piston and the cylinder.

317 X Q. Do you find any warrant whatever in the specification

or drawings of patent 217,838 for making the piston D one
 1122 sixty-fourth of an inch smaller than the cylinder in which
 it works, or for making any provision whatever for leakage
 around said piston. If so, please indicate specifically by reference
 to the patent, what you consider to be your warrant for such a va-
 riation from it?

A. I find no specific statement as to the relative size of the piston
 in reference to the cylinder in which it works; however, my war-
 rant for using my judgment in constructing the device, I take from
 the following quotation (page 2, column 1, paragraph 2.)

"The form or construction, of the relief valve, its function and
 operation being substantially retained, *may be varied considerably*, in
 so far as it is an element in the described combination, without any
 material departure from the scope of the invention." (The italics
 are my own.)

318 X Q. Is it possible that you pretend, or desire the court to
 understand, that you believe the quotation you have made from
 the patent approaches in the slightest degree to a warrant or in-
 struction to a mechanic to make provision for leakage around the
 piston D, in constructing the device of patent 217,838?

A. I do, and I wish the court to understand that that is the way
 I interpret the specification.

319 X Q. Did you note, and can you state, the time required for
 effecting the application of the brakes by graduation, when using
 the devices of patent 217,838, modified as you have stated by the
 provision of a leakage space around the piston D?

A. I did not note, or take the time for graduation applications
 when the devices of patent 217,838 were used.

320 X Q. You are then unable to state whether or not the applica-
 tion of the brakes was made when graduating in the time that would
 be required to be usefully operative for practical purposes?

A. I am. As I before stated I was not experimenting to ascer-
 tain the *degree of efficiency* of the device, or with a view to put it in
 the *best order* or condition for practical purposes; I merely
 1123 wished to ascertain if the device would quicken the action of
 the brakes, graduate and release them, without destroying
 either of the operations.

321 X Q. Now, as to release, which, as you will probably recog-
 nize, is a matter of some little importance, as to useful operativeness
 in practical service. You say, "I then released the brakes in the
 regular manner, by admitting air to the train-pipe, and the brakes
 all released."

Did you note, and can you state, how long it took them to release?

A. I did not time the release, and therefore cannot state the exact
 time, although the brakes released in about the same manner that
 the brakes usually release when the rack is equipped with our regu-
 lar quick-action valve.

322 X Q. I am asking you only as to the *time* of release, and
 nothing as to the manner. Is it not the fact that the time of release
 was greatly longer than under ordinary conditions, and much too
 long to comply with the requirements of practical service?

A. No, it was not a great deal longer, if any, nor was it of such a duration of time that it would be impracticable in operation in service.

323 X Q. Did you time the release?

A. No, I did not.

324 X Q. Now as to charging. You say, "I then charged the brakes with 70 pounds air pressure." How long did it take you to charge the train?

A. I did not time it.

325 X Q. Did it not take, as far as you observed, a materially longer time to charge the train with 70 pounds of air pressure than is the case in usual and correct practice?

A. No, it didn't take a *materially* longer time, but my recollection is that it was somewhat longer, although I didn't take any time.

326 X Q. You say, referring to the device of patent 217,838, that it "does not obstruct the feeding or charging process." Is it not obvious on inspection to any mechanic that the presence in a train line of a series of spring-pressed valves, each of which must be unseated, in feeding or charging, necessarily must obstruct that process?

A. I should say it was if the springs are of such a tension that it required a considerable preponderance of pressure to overcome the spring, but in the device shown in patent 217,838, I can see no reason or advantage in having a spring of any greater tension than is just sufficient to move the valve to its seat. My opinion, however, is that the device would work equally well if no spring was employed at all, simply because when the air pressure moves from aperture B to A, that pressure would close the valve E.

All of the answer succeeding the word "was" objected to as not responsive.

327 X Q. Wholly regardless of the *degree* of tension of the springs, is it not self-evident that the presence in the train line of a series of valves which must be unseated in feeding or charging, must necessarily affect that operation?

A. No.

328 X Q. Then am I to understand that you are under the impression that the feeding and charging of the train line could be performed just as well and just as quickly when provided with a series of the appliances of patent 217,838, as could be done in the ordinary train line?

A. My opinion is it would take some longer time, just to what degree I can't say, but the delay would not be sufficient to interfere with the practical operation, or charging of the brakes.

329 X Q. That delay, however the extent of which you do not know, would be due altogether, would it not, to the obstruction of the train line by the devices of patent 217,838. If you shall say that it would not be, please state what you think it would be due to.

A. I have stated the charging would be somewhat slower, but if I was going to make the devices, using such judgment as the patent licenses me to use, I should make a device in accord-

ance with that patent and would charge the train and brakes for all practical purposes just as quickly as through the devices were not used in the train-pipe. The delay, however, which I have referred to, in some of my preceding answers, would be caused by the devices as shown in patent 217,838.

330 X Q. Could not the last question have been truthfully answered by the single word "yes," without the slightest qualification whatever?

A. It could have, but I thought it was proper for me to express my opinion on the matter under discussion.

331 X Q. Did the opinion which you expressed, in the slightest degree qualify a direct affirmative answer to the question?

A. It does, to the extent that I was making devices under the guidance of the patent, and using my judgment, as a skilled air-brake mechanic.

332 X Q. Were you asked anything about the probable results of your efforts to accomplish the feat of making the passage of air through an obstructed pipe as easy and rapid as through an unobstructed one?

A. No, I was not asked for my opinion.

333 X Q. You say that you charged the brakes with 70 pounds pressure, and "applied for an emergency application." How did you manage to apply for an emergency application, if, as you state, the triple valves which you used were "plain triple valves," and "of a character which will not produce quick action"?

A. I threw the handle of the engineers' valve to that position in which the train-pipe air would be discharged fully, and let it remain in that position until all the air was discharged from the said train-pipe.

334 X Q. I presume you mean by that that you manipulated the engineers' valve in such a way that a quick-action or emergency application would have been effected if you had been using quick-action triple valves. Am I right?

A. In a sense, you are, that is to say, that you could place the engineers' valve in the emergency-application position, and
1126 leave it remain open; but in producing a "quick action" with the quick-action valves as now generally used in practice, the engineers' valve is manipulated sometimes in such a manner that the train-pipe is first discharged of about 20 to 30 pounds pressure, and then the engineers' valve is blanked. Of these two ways, I used the first, that is to say, I placed the engineers' valve in full open position, and let it remain there until the pressure had equalized in the 50th brake-cylinder and auxiliary reservoir.

335 X Q. You say I am right in a sense. Am I not right in every sense, and if not, in what sense am I wrong?

A. No, you are not right, as I understand the matter. I have stated that there are two ways of manipulating the engineers' valve in producing quick action. You asked me in question 333, "How did you manage to apply for an emergency application." I replied by stating that I threw the handle of the engineers' valve in a certain position. You then asked me in question 334 if I put it in that

position for a quick-action or emergency application, when the quick-action triple valves were used. I then stated in a sense you are right, meaning by that, that I did place the engineers' valve in one of the positions, and held it there, that is used in producing emergency application of the quick-acting valves now in use. That is what I meant by "in a sense."

336 X Q. X Q. 334 did not say a word about "the position" of the engineers' valve, and simply asked you whether or not "you manipulated the engineers' valve in such a way that a quick-action or emergency application would have been effected if you had been using quick-action triple valves." Did you or did you not do so?

A. I did so.

337 X Q. Then whether there are two, or two hundred, or two thousand ways of manipulating the engineers' valve to effect a quick-action or emergency application, I was right in *every* sense, was I not, in the statement made in X Q. 334?

1127 A. You were. Had I understood your question at first as fully as I did when you repeated it, I would have made the answer that I did when you repeated it.

338 X Q. After you made, in your test, an application of the brakes in which the valves F opened the release port C, the pistons D dropped below the shoulders s, and there was then an open communication between the train-pipe and the atmosphere through each of the appliances of patent 217,838. This is a fact, is it not?

A. As I understand your question, there was.

339 X Q. How was it that when you attempted to recharge the train line, the air did not escape therefrom through these open communications to the atmosphere?

A. Because when the air was again admitted to the train-pipe from the storage reservoir, it passed into the aperture A and acted on the piston D, thereby moving the piston and valve F to the closed position, as shown in Figs. 1 and 3.

340 X Q. Did not the first portion of the air which was admitted to each of the appliances when recharging, escape through the then open communication, before the piston closed the valve?

A. I did not observe that any escaped. All the valves promptly closed throughout the train.

341 X Q. Are you prepared to say, and do you say, that the first portion of the air admitted to each of the appliances in recharging did not escape through the then open port C before the piston closed the valve F on that port?

A. I am prepared to say that if there was any escape, it was of such a small quantity, that it was not appreciable, as in making all the tests, the valves or devices of patent 217,838, closed so promptly that all the brakes were released.

342 X Q. You do not, however, know how much air was wasted in this way; how much delay in charging, and how much delay in releasing the brakes was involved. This is a fact, is it not?

1128 A. If there was any waste of air, or delay in charging and releasing the brakes, it was of such a nature that it was not

perceptible. I did not experiment to ascertain just what these conditions were, if the conditions existed.

Answer objected to, as not responsive.

X Q. 342 repeated, and a categorical answer requested.

A. I do not, but if there was such waste and delay as you mention, they were of such a nature that it didn't interfere with the practical operation.

All of the answer succeeding the word "not" objected to, as not responsive, and further as incompetent, in view of the witness' admissions that he did not take note of the quantity of air wasted, or of the time required for charging and releasing.

343 X Q. Did the tests which you made with the device of patent 217,838, demonstrate that said device was practically operative in anywise for admitting air in the application of the brake directly from the main air pipe to the brake-cylinder?

A. They did not.

344 X Q. Did the tests which you made with the device of patent 217,838, demonstrate that said device was in anywise practically operative to admit air from the auxiliary reservoir to the brake-cylinder by preliminary traverse of the triple-valve piston, and to admit air directly from the main air pipe to the brake-cylinder by a further traverse of the triple-valve piston?

A. They did not.

345 X Q. Did the tests which you made with the device of patent 217,838, demonstrate that said device was practically operative to a degree sufficient to warrant you or any other capable air-brake constructor in advising its adoption in practical railway service?

A. The tests demonstrated that the device would quicken the action of the brakes; and they demonstrated to my mind, as I think they would to any one who is skilled in air brakes, that the device of patent 217,838 could be so arranged and modified to suit the automatic air brake as to make it just as efficient a brake as those now in general use, and one that could be recommended to railroad officials for practical use.

Answer objected to as not responsive.

346 X Q. X Q. 345 repeated.

A. The results produced by the devices of patent 217,838, as I tried them, were not of an efficiency that would justify me in recommending the use of the devices to railroad officials.

347 X Q. Did the tests which you made with the device of patent 217,838 demonstrate that said device was practically operative to such a degree as to lead you to believe that it would be acceptable to, and accepted by, any competent railroad official, for use in practical railroad air-brake service?

A. The tests I made with the device of patent 217,838 demonstrates that the device, as I made them, was not practically operative to be used in service; but they demonstrated that the device of patent 217,838 could be so modified that it would practically be oper-

ative in railroad service. As to being able to get railroad officials to adopt it, that is something I cannot say, as I might be able, then again I might not.

348 X Q. I am not asking you anything about what possibly might be the case if the device was modified, as it is quite evident that in the light of subsequent invention, it might be modified so materially as possibly to be converted into something that was practically operative. I am, however, asking you as an expert, whether in your opinion the tests made by you demonstrated that the device as it is, was practically operative to such a degree as would lead you to believe that a competent railroad official would accept it for practical service on *its* road. Please let me have your opinion on this point.

A. My opinion is that the device, *as I used it*, would not be acceptable to railroad officials, for practical use.

Counsel for complainants now closes the cross-examination of the witness, and asks of counsel for defendants upon the record whether or not he will consent, first, that a repetition of the 1130 experiments recited by the witness in his deposition-in-chief shall be made by him in the presence of complainants' counsel and experts, at such early day as may be suitable to the engagements of both counsel; and, second, whether he will furnish to complainants' counsel the 50 valve devices of patent 217,838, with which the witness' tests were made, in order that the complainants may make tests thereof upon their own testing rack.

Counsel for defendants states that before making answer to the request which counsel for complainants has made, he desires time to consult with the principal counsel in the case, and states that he will communicate with the counsel who is out of the city, and will make a definite answer as soon as he shall be advised by the principal counsel, which will probably be by the 11th day of April.

Counsel for complainants will be obliged if defendants' counsel will advise him by wire of his decision in the matter, in order that if a repetition of the experiments is to be made, it may be done as early as practicable, and in view of the engagements of complainants' counsel, it is doubtful whether he would be able to attend for the purpose except on some day in the latter part of next week.

Counsel for defendants replies that he will wire counsel for complainants his answer within the time already named.

GEORGE A. BOYDEN.

LEVEN J. GWINN, a witness produced on behalf of the defendants, having been duly sworn, deposes and says, in answers to interrogatories propounded to him by Charles B. Mann, Esq., of counsel for defendants, as follows, to wit:

1133 1 Q. What is your name, age, residence and occupation?

A. Leven J. Gwinn; 31 years old; Baltimore; machinist and mechanical draftsman.

2 Q. Please look at the drawing of patent granted to George Westinghouse, Jr., July 22, 1879, No. 217,838, and state what part you

took in making working drawings for the construction of the device shown therein?

A. I made all the detail working drawings and sketches necessary for constructing the devices shown therein from the original drawing made by George A. Boyden, which he made from drawings of patent No. 217,838, in my presence. I also made two drawings from same original drawing to be used as exhibits in taking this testimony; one being a device shown in patent No. 217,838, and the other being the same device attached to the key of an angle cock. I identify this drawing, marked "Defendants' Exhibit Copy of Working Drawing, Patent 217,838, July 22, 1879," as the drawing I made from the original drawing made by Mr. Boyden. Here is another drawing I identify, marked "Defendants' Exhibit Tracing of Working Drawing, Patent 217,838, on Angle Cock."

3 Q. Please state whether or not the drawing marked "Defendants' Exhibit Copy of Working Drawing, Patent No. 217,838, July 22, 1879," (Fig. 16,) shows the same construction as that of Fig. 1 in the drawing of patent 217,838? (See Fig. 15.)

(Here follows diagram marked p. 1132.)

A. It does show the same construction.

4 Q. Please state what steps were taken by Mr. Boyden's orders to make devices like that shown in patent No. 217,838?

A. I was ordered to have patterns made, and to get castings made off of same, and to fit up one or two of the devices or relief valves, shown in Westinghouse patent 217,838, which I did. I was then ordered to make a dozen more, and finally 50 of them were made.

5 Q. State whether or not the devices which you referred to as made in accordance with patent 217,838, were tested?

1134 A. They were tested. They were tested on a test-rack in the Boyden Brake Company's shops. This rack has 50 complete automatic air brakes on it, consisting of 50 auxiliary reservoirs, brake-cylinders and plain triple valves, with engineers' valve, gauges, and about 1,900 feet of inch and a quarter train-pipe, with angle cocks, str-ight cut-out cocks, hose and couplings, and an air pump or compressor, and other necessities pertaining to a test-rack for making air-brake tests. 49 of the devices made from patent 217,838 were each attached to one half section of hose couplings throughout the train, and one was attached to the key of an angle cock in a vertical position with the relief or discharge port C, downwards.

6 Q. Briefly describe the tests that were made on that test-rack, to ascertain the operativeness of the devices constructed according to patent 217,838?

A. We proceeded to test, by placing the engineers' valve in full release position; we then started the air compressor, charging all the auxiliary reservoirs and train pipe to 70 pounds pressure; then by placing the engineers' valve handle in the graduating position and gradually reducing the train-pipe pressure, putting about 20 pounds of air in the brake-cylinder. The 50 relief valves or devices

1132

did not discharge any air during this application of the brake. We then placed the engineers' valve handle on the lap or blank position, the air holding the brakes in the applied position. We then placed the engineers' valve handle in full release position to release the brakes, and recharge the auxiliary reservoirs and train-pipe to 70 pounds pressure. We then placed the engineers' valve handle in a quick action or full emergency position, suddenly discharging the train-pipe air at the engineers' valve, thereby causing the brakes to take a quick action and equalizing in the 50th brake-cylinder and auxiliary reservoir at 45 pounds. We then released the brakes by placing the engineers' valve in full release position, and recharging the auxiliary reservoirs and train-pipe to 70 pounds pressure, and uncoupling the hose couplings in train-pipe at 1135 the 25th brake, representing a train breaking in two; the train-pipe air being suddenly reduced at that point, causing the relief valves on the twenty-five rear couplings to uncover discharge ports C to the atmosphere and discharging a portion of the air therefrom, causing the rear 25 brakes to take a quick action, and the 25 brakes nearest the engine to take a full service application. The 50th brake-cylinder and auxiliary reservoir and the first, equalizing at 45 pounds. We then took off all the relief valves and replaced the spiders and caps to hose couplings, thereby making them as usual hose couplings, and recharged the auxiliary reservoirs and train-pipe to 70 pounds pressure. We then placed the engineers' valve in the quick-action position, or full emergency position, and suddenly discharging the train-pipe air, the brakes applied, but not with a quick action, they equalized at 45 pounds in the 50th brake-cylinder and auxiliary reservoir.

7 Q. Please state what you mean by the expressing "causing the brakes to take a quick action."

A. I mean that discharging the train-pipe air suddenly, caused the brakes to move out or apply quickly.

8 Q. Please state, as near as you can, the time that was required in applying the brakes when the device of patent 217,838 was used, and the time required in applying the brakes when that device was not used.

A. In applying the brakes when device 217,838 was used, the quickest time, from the movement of the engineers' valve handle until the 50th brake-cylinder and auxiliary reservoir equalized, was eight seconds; when applying the brakes while devices 217,838 were not used, the quickest time from the movement of the engineers' valve handle until the 50th brake-cylinder and auxiliary reservoir equalized, was 30 seconds.

9 Q. State what particular position the valve devices of patent 217,838 had in making the tests which you have described.

A. 49 of them were applied in a horizontal position, and one was applied in a vertical position, with the relief or discharge port C downward.

1136 10 Q. As you are familiar with air brakes, please state what particular position the valve device of patent 217,838

should have, in your opinion, in order to get the best operative results.

Objected to, as incompetent, it not having been shown that the witness is familiar with air brakes, or capable of forming an opinion intelligently as to the best operative results of the devices connected therewith.

A. I have been employed with the Boyden Air Brake Company for the past five years, as a machinist, and mechanical draftsman; am at present holding a position with the said company as general foreman. I have been sent by the Boyden Brake Company several times to superintend the application of air brakes to freight cars and to locomotives on railroads at points distant from Baltimore; I have also been sent by them to look after complaints of brakes not working right, or being out of order, from various causes, all of which I have replaced in working order.

In answer to your question, my opinion is, that the device should be applied in a vertical position, with relief port C downward, to prevent dirt and foreign substances getting therein.

Adjourned to Saturday, April 7, 1894, at 10 a. m.

SATURDAY, April 7, 1894.

Met pursuant to adjournment.

Present: Counsel as before.

Direct examination of Mr. L. J. GWINN resumed:

A. (Resuming:) This position also ensures that the relief port C will be closed by the gravity of piston D and valve F when starting to charge the train-pipe with air.

11 Q. Please state whether or not the tests Mr. Boyden and you made on the test-rack with devices constructed according to patent 217,838, developed any difficulty that suggested said devices were inoperative.

1137 A. No, there was nothing occurred during the tests that suggested to me that the devices were inoperative; to the contrary, they all operated as I expected them to operate, and as I constructed them to operate.

Cross-examination by J. SNOWDEN BELL, Esq., counsel for complainants:

12 X Q. Did you personally do the turning, boring and other machine work necessary to fit up the 50 devices of patent 217,838, with which the tests were made, or was this done by a machinist working under your orders as general foreman of the Boyden Brake Company?

A. It was done under my orders, as foreman of the Boyden Brake Company, by a machinist and workman.

13 X Q. I notice that the original working drawing which you say was made by Mr. Boyden, marked "Defendants' Exhibit Working Drawing, Patent 217,838, on Angle Cock," shows the piston to

be about one thirty-second of an inch smaller than the bore of the casing in which it fits, so as to leave a space of about one sixty-fourth of an inch all around the piston between its periphery and the bore of the casing in which it fits; this is a fact, is it not?

A. The drawing does show the piston about one thirty-second smaller than the bore.

14 X Q. Were the 50 devices of patent 217,838, with which the tests were made, fitted up in accordance with the working drawing in the particulars stated in the last question; that is to say, with their pistons (the pistons D of the patent) about one thirty-second of an inch smaller than the bore of the casings in which they were?

A. The devices were fitted up with the pistons about a sixty-fourth smaller than the bore of the casing in which they worked.

15 X Q. Why did you not follow the original drawings and make them about one thirty-second of an inch smaller as shown in said drawing?

1138 A. Because in putting the line in the drawing, there was no particular measurement made, the lines were put in by the eye, intending them to be about one sixty-fourth smaller than the bore.

So much of the answer as relates to what was the intention in making the drawing objected to as incompetent, for the reason that the witness has testified that the drawing was made not by himself but by Mr. Boyden.

16 X Q. Did Mr. Boyden instruct you to make the pistons smaller than the bores of the casings in which they worked; and if so, how much smaller did he tell you to make them?

A. Mr. Boyden did instruct me to make the pistons one sixty-fourth of an inch smaller than the bore of the casing.

17 X Q. You say that Mr. Boyden made this original drawing in your presence from the drawings of patent 217,838. Do the drawings of patent 217,838 show the piston D as being smaller than the bore of the casing in which it fits; that is to say, do they show any space whatever between the periphery of the piston and the bore of the casing?

Counsel for defendants objects to the question as being wholly immaterial; the drawing in the patent not being a working drawing.

To which complainants' counsel replies that the question is intended to test the accuracy of the statement that the original drawing in evidence was made from the drawing in the patent.

A. The drawing of patent 217,838 does not show any space between piston and bore of casing.

18 X Q. Does the drawing of patent 217,838 show an angle cock, or show a valve device connected to an angle cock?

A. It does not.

19 X Q. Does the specification of patent 217,838 instruct that the

1139 piston D is to be made smaller than the bore of the casing in which it works, or that any space is to be provided for the passage of air around said piston?

A. I cannot say, as I have not carefully read the specification.

20 X Q. In making the drawing "Defendants' Exhibit Copy of Working Drawing, Patent 217,838, July 22, 1879," and the tracing "Defendants' Exhibit Tracing of Working Drawing, Patent 217,838, on Angle Cock," why did you not make said drawing and tracing correspond with the original drawing, that is to say, by showing on them the piston as about one thirty-second of an inch smaller than the bore of the casing in which it works, as is shown in said original drawing?

A. If the tracing does not show the piston smaller, it was purely a mistake on my part, as I made the tracing hurriedly, and leaving out the lines showing piston smaller than bore by mistake, or oversight.

21 X Q. It is a fact, is it not, that the tracing *does not* show the piston as about one thirty-second of an inch smaller than the bore as the original working drawing does, but shows it as closely fitting in the bore, just as the patent drawings do?

A. It is a fact that the piston shown in tracing does not fit loose in bore of casing.

22 X Q. You mean then to answer the last preceding question specifically in the affirmative, and could have truthfully answered that question by the word "yes"? This is a fact is it not?

A. I could have answered the last preceding question with the single word "yes."

23 X Q. And it is also true, is it not, that the drawing "Defendants' Exhibit Working Drawing, Patent No. 217,838, July 22, 1879," does not correspond with the original drawing in showing the piston as about one thirty-second of an inch smaller than the bore of the casing in which it works, but shows it as closely fitting in the bore just as the patent drawings show it?

A. Yes, it does.

1140 24 X Q. Was this difference between the drawing last referred to and the original working drawing also a matter of oversight on your part?

A. It was.

24 X Q. Were you instructed for what reason you were to make the pistons of the devices which you were fitting up one sixty-fourth of an inch smaller than the bore of the casings in which they were to work?

A. I was not.

26 X Q. From your experience as a mechanic skilled in air brakes, please state whether or not it would be possible to make a graduated application of the brakes when using the device of patent 217,838, if the pistons D are made to fit the bore of the casing in which they work as shown in the drawings of the patent?

A. My opinion is that you could make a graduated application with the piston D fitting closely to the casing.

27 X Q. Did you ever try to do so?

A. I have tried to do so.

28 X Q. Did you succeed?

A. I did.

29 X Q. How long did it take to make the application under such circumstances?

A. That I could not say, as I did not time the application.

30 X Q. In the tests made by Mr. Boyden with these devices, at which you assisted, did you make any note of the time required for charging, the time required for releasing, or the time required for making a graduated application?

A. I did not.

31 X Q. And I presume that you are unable to state the time required for either of the operations specified in the last preceding question?

A. I am unable to state the time.

32 X Q. As a mechanic skilled in air brakes, please state whether or not you consider the device of patent 217,838 to be practically operative to such an extent that it would be acceptable to, and accepted by, any competent railroad man for regular service on his road?

A. I do.

33 X Q. In this particular then, you do not agree with Mr. Boyden, do you, as he states that in his opinion it would not be acceptable to railroad officials for practical use?

A. I don't agree with Mr. Boyden in that respect.

LEVEN J. GWINN.

Adjourned *sine die*.

United States Circuit Court for the District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WEST-
INGHOUSE AIR BRAKE COMPANY

vs.

BOYDEN POWER BRAKE CO.; GEORGE A. BOY-
den, President; Charles B. Mann, Secre-
tary, and William Whitridge, Treasurer.

In Equity. No. 321.

Notice to Counsel for Complainants.

Counsel for defendants, referring to the request made on the record by counsel for complainants, Friday, April 6th, 1894, asking for a repetition in the presence of complainants' experts and their counsel, of the experiments testified to by Mr. Boyden, and which were made by him and Mr. Gwinn for the purpose of ascer-
1142 taining the operativeness of devices constructed in accordance with U. S. patent No. 217,838, dated July 22nd, 1879, granted George Westinghouse, Jr., now desires to make further response to that request as follows:

Defendants are ready and willing to exhibit the said experiments and tests on Thursday, April 12th, 1894, at 2 p. m. in the presence of counsel and two expert witnesses on behalf of complainants,

under such conditions as will be reasonable for both parties, with the object in view of guarding against possible misrepresentation thereafter as to what were the actual results shown by the said experiments and tests. And counsel for defendants proposes the following conditions, to wit:

First, that the defendants be represented at the tests by one counsel and two witnesses and complainants be represented by a like number.

Second, that while making the tests and experiments notes or written memoranda shall be kept of the tests and experiments as made and of the results of the same.

Third, that from said notes or memoranda the persons present as witnesses for defendants, shall prepare a written statement briefly describing and setting forth the tests and experiments and the results of each test, and that each witness present on behalf of defendants may be called the next morning, Friday, April 13, 1894, at 10.30 o'clock to testify and subscribe to this statement under oath, subject, of course, to the cross-examination of counsel for complainants.

Respectfully,

CHAS. B. MANN,
For Defendants.

Baltimore, Maryland, April 10th, 1894.

BALTIMORE, MD., April 13, 1894.

1143 Testimony on behalf of defendants, taken in accordance with the foregoing notice, at the office, No. 544 Equitable building.

Present: Charles B. Mann, Esq., of counsel for defendants; J. Snowden Bell, Esq., of counsel for complainants.

GEORGE A. BOYDEN, being recalled, deposes and says, in answer to interrogatories propounded to him by Charles B. Mann, Esq., of counsel for defendants, as follows, to wit:

349 Q. Are you the same George A. Boyden who has heretofore testified in this cause?

A. I am.

350 Q. Please give an account of the repetition of the experiments and tests with valve devices constructed according to patent 217,838, made yesterday at the shops of the Boyden Brake Company, which experiments and tests you and Mr. Gwinn have heretofore testified to; and also state the occurrences that took place on that occasion.

A. Yesterday at the shop of the Boyden Brake Company, I repeated the tests referred to in your question, in the presence of Messrs. J. Snowden Bell, H. H. Westinghouse and D. L. Barnes, representing the complainants, and Mr. Chas. B. Mann, L. Gwinn and myself, representing the defendants.

The tests made and the results were as follows:

Fifty automatic air brakes having the capacity of automatic air brakes as used in the year 1879, were mounted on the test-rack heretofore described, with relief valves constructed in accordance

with U. S. patent, No. 217,838, dated July 22, 1879, granted George Westinghouse, Jr.

First. The apparatus was charged with about 70 pounds of air pressure, all the auxiliary reservoirs charging up.

Second. The engineers' valve handle was placed in the "graduating position" and all the brakes were gradually applied, the degree of application being varied as desired.

1144 Third. The engineers' valve was then placed in position to release the brakes, and all the brakes released.

Fourth. The brakes were then again charged with about 70 pounds air pressure.

Fifth. The engineers' valve was then placed in position for "emergency" applications, and all the brakes quickly applied; the time required from the movement of the engineers' valve until the pressure equalized in the fiftieth brake-cylinder and auxiliary reservoir, was about ten and one-half seconds.

Sixth. The engineers' valve was then moved to release the brakes; all the brakes released but one. The occasional non-release of a brake in a train of 50 cars is not an unusual thing with the best brakes in use today. The failure of this one brake out of the fifty to release, was not attributable to the device of patent, No. 217,838. The apparatus was then recharged with about 70 pounds air pressure.

Seventh. The twenty-fifth hose coupling was then uncoupled to represent an automatic action of the brakes as occurs in the practical use of brakes when a train accidentally separates or breaks into two sections. In this test the twenty-five brakes on the rear end of the test-rack applied *quickly*. The twenty-five brakes on the forward end of the test-rack applied more slowly, which would be the preferable manner in practice, because the forward part of the train would move far enough ahead to prevent the rear part from colliding with it, as the rear section would be stopped in a shorter distance than the front section would be.

Eighth. We now removed all valves of patent, No. 217,838, and restored the caps of the hose coupling; the test-rack being now equipped with automatic brakes having the capacity of air brakes as in 1879, using "plain triple valves."

Ninth. The brakes were then recharged with air pressure.

Tenth. The engineers' valve was then again placed in position for an "emergency" application. This test was the same as 1145 in the fifth test, except that none of the relief valves of patent, No. 217,838, were used. In this test all the brakes applied, *but much slower* than they did in the said fifth test; the time now required from the movement of the engineers' valve until the pressure equalized in the fiftieth brake-cylinder and auxiliary reservoir was about 31 seconds, or twenty and a half seconds slower than when using the valve device of patent 217,838.

The foregoing comprised the tests made on the test-rack relative to the operativeness of the device of patent, No. 217,838, which Mr. Gwinn and I mentioned in our previous testimony.

The main points or substance of this account which I have now

given of these repeated tests, were gone over and stated aloud in the presence and hearing of all the persons in attendance while these tests were being made, including the three representatives of the complainants in this suit, and they and we all agreed that said main points of the tests were fairly and correctly stated.

After these tests had been made, the representatives of the complainants made inquiry of the representatives of the defendants asking in effect if we would make some further experiments, and suggesting that they wanted to put the engineers' valve in the "running position" to see how the brakes would release in that position. As this "running position" is one that is not used in practice to release the brakes, I declined to make this test; because first, the proposed test would be more severe than the standard brakes of today are subjected to in practice when releasing; and, second, the valve devices of patent 217,838, which I had constructed, were *not* made for the purpose of comparing *their* action with that of the standard brakes of 1894, *fifteen years after the invention of patent 217,838*. These valve devices were made simply to demonstrate if they would work as set forth in the specification thereof, which they do, and having demonstrated this, it would not be consistent to make the test solicited by complainants' counsel, as neither 1146 the valve device of patent No. 217,838, nor any other brake-valve, were intended to release under the conditions named in the solicited test.

The complainants' counsel also requested that we should have new pistons made which would tightly fit in the cylinders of the devices of patent 217,838. This was also declined, because, I know the devices are made in accordance with patent 217,838, for the simple reason that they work as the specification of that patent states they should work, and they produce the result which the devices of patent 217,838, of 1879, were invented to produce.

Cross-examination by J. SNOWDEN BELL, Esq., of counsel for complainants:

351 X Q. When you say that the 50 automatic air brakes used in the test of yesterday were provided with "relief valves constructed in accordance with U. S. patent No. 217,838, dated July 22, 1879, granted to George Westinghouse, Jr.," you refer, do you not, to the appliances made under your direction, and referred to in the testimony given last week by yourself and Mr. Gwynn, in which appliances the pistons were made one sixty-fourth of an inch less in diameter than the casing in which they worked?

A. I do.

352 X Q. When you say, referring to yesterday's proceedings, that "they (the three representatives of the complainants) and we all agreed that said main points of the tests were fairly and correctly stated," you refer, do you not, to the verbal statements made in the course of these demonstrations?

A. I refer to the conversation we had after the tests. Mr. H. H. Westinghouse suggested that before separating he thought it was

well for us to have an understanding between us all if we agreed on the results, of the tests; and this is what I referred to in my answer, pertaining to our mutual understanding.

353 X Q. You say that at yesterday's tests, the complainants' counsel requested that you would have new pistons made, etc.

1147 Are you not in error as to this statement, and is it not the fact that what complainants' counsel requested was that you would make a test with devices having their pistons fitting the cylinders without the slackness of a difference of one sixty-fourth of an inch in diameter between the pistons and the cylinders which exists in the devices with which the tests were made?

A. I did not make a note of the exact phraseology used by the complainants' counsel, but my understanding at the time was that he wished a test made with pistons fitting the cylinders more tightly than those that were used; as we did not have such pistons, I could only make such a test by first having new pistons made, which would have taken considerable time, and was one of the reasons why I declined.

Counsel for complainants calls the attention of counsel for defendants, that his request made at our last session, as yet remains unanswered, such request being that complainants' counsel should be furnished with the 50 valve devices of patent 217,838, with which Mr. Boyden's tests were made in order that the complainants' may make test thereof upon their own testing rack. This request was made partly for the purpose of enabling the complainants to verify the correctness of the tests heretofore made, and partly to enable the court to be more fully informed as to the question of the operativeness in practice of the devices, without involving the delay which will be caused if complainants are obliged to duplicate these devices for their own experiments. A reply on the record to this request is now asked for.

Counsel for defendants replies that defendants have fully exhibited the devices and repeated the tests which they previously made, in the presence of counsel for complainants and two expert witnesses, and having done this, counsel does not perceive that defendants are under any obligation to furnish complainants with their devices, and accordingly declines.

G. A. BOYDEN.

1148 LEVEN J. GWINN, being recalled, deposes and says, in answer to interrogatories propounded to him by Charles B. Mann, Esq., of counsel for defendants, as follows:

34 Q. Are you the same Leven J. Gwinn who has heretofore testified in this cause?

A. I am.

35 Q. Please state whether you were present yesterday at the shops of the Boyden Brake Company, while the experiments and tests were made, to which Mr. Boyden has testified this morning in answer to question 350, and if yea, state whether you have read the

statement made by Mr. Boyden, in answer to that question, and whether the same is true and correct.

A. I have read carefully the statement made by Mr. Boyden this morning in answer to question 350, in which he gives an account of the repetition of tests he made yesterday in the presence of the three representatives of the Westinghouse Air-brake Company. I was present during those tests, and assisted in making them. Mr. Boyden's statement is true, and an accurate account of what was done on that occasion.

Cross examination by J. SNOWDEN BELL, Esq., of counsel for complainants:

36 Q. Do you agree substantially with Mr. Boyden in the answers he gave this morning to my cross-questions?

A. I do agree with Mr. Boyden in regard to his answer to cross-question 351; as to the other two cross-questions, I wasn't present during the conversations referred to and therefore cannot say whether those two answers are correct or not.

LEVEN J. GWINN.

Adjourned *sine die*.

1149 & 1150 United States Circuit Court in the District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WEST-
INGHOUSE AIR BRAKE COMPANY
vs.

BOYDEN POWER BRAKE CO.; GEORGE A.
Boyden, President; Charles B. Mann, Secre-
tary, William Whitridge, Treasurer.

In Equity. No. 321.

I, George Morris Bond, a United States commissioner as afore-said, before whom the within depositions were taken, do hereby certify that on the 4th day of April, 1894, and on the various days adjourned therefrom, ending on the 13th day of April, 1894, the several sittings hereinafter noted were attended by counsel of the complainants and defendants in the above-entitled cause and by the witnesses, George A. Boyden, who was recalled, and Leven J. Gwinn, and that said Gwinn was by me duly sworn, and the testimony of both witnesses was then reduced to writing by my sworn clerk, and thereafter subscribed by the said witnesses.

And I do further certify that I am not of counsel or attorney for either of the parties to the said cause, and that I am not interested in the event of the said cause.

Given under my hand and seal at the city of Baltimore, within the district of Maryland, this thirteenth day of
[COM'R'S SEAL.] April, in the year of our Lord one thousand eight hundred and ninety-four.

GEORGE MORRIS BOND,
U. S. Commissioner for Maryland.

1151 DEFENDANTS' EXHIBIT "COPY OF WESTINGHOUSE FILE-WRAPPER AND CONTENTS" OF PATENT No. 360,070.

DEPARTMENT OF THE INTERIOR,
UNITED STATES PATENT OFFICE.

To all persons to whom these presents shall come, Greeting :

This is to certify that the annexed is a true copy from the files of this office of the file-wrapper and contents in the matter of the letters patent granted George Westinghouse, Jr., March 29, 1887, number 360,070, for improvement in fluid-pressure automatic brake mechanism.

In testimony whereof I, C. E. Mitchell, Commissioner of Patents, have caused the seal of the Patent Office to be affixed this [SEAL.] 14th day of December, in the year of our Lord one thousand eight hundred and eighty-nine, and of the Independence of the United States the one hundred and fourteenth.

C. E. MITCHELL,
Commissioner.

1152 To the Commissioner of Patents :

Your petitioner, George Westinghouse, Jr., residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, a citizen of the United States, respectfully prays that letters patent of the United States may be granted to him for the improvements in fluid-pressure automatic brake mechanism set forth in the annexed specification; and he hereby appoints [George H. ^{J. Snowden} Bell,

Christy,]* of Pittsburgh, Pennsylvania, his attorney, with full power of substitution and revocation, to prosecute this application, to alter and amend the specification, to appeal or withdraw in case of rejection, to receive the patent when granted, and to transact all business in the Patent Office relative thereto.

GEORGE WESTINGHOUSE, JR.

[* Words enclosed in brackets erased in copy.]

1153

Specification.

To all whom it may concern :

Be it known, that I, George Westinghouse Jr. residing at Pittsburgh in the county of Allegheny and State of Pennsylvania, a citizen of the United States, have invented or discovered certain new and useful improvements in fluid-pressure automatic brake mechanism of which improvements the following is a specification :

1154 The object of my invention is to enable the application of brake-shoes to car wheels by fluid pressure to be effected with greater rapidity and effectiveness than heretofore, more particularly in trains of considerable length, as well as to economize compressed air in the operation of braking by utilizing in the brake-cylinders the greater portion of the volume of air which, in former practice, was directly discharged into the atmosphere. To this end, my invention, generally stated, consists in a novel combination of a brake-pipe, an auxiliary reservoir, a brake-cylinder, and a "triple-valve" device governing, primarily, communication between the auxiliary reservoir and the brake-cylinder, and secondarily, communication directly from the brake-pipe to the brake-cylinder. The improvements claimed are hereinafter fully set forth.

15 In the application of the Westinghouse automatic brake as heretofore and at present commonly in use, each car is provided with a main air pipe, an auxiliary reservoir, a brake-cylinder, and a triple valve, the triple valve having three connections, to wit : one to the main air-brake pipe, one to the auxiliary reservoir, and one to the brake-cylinder. The main air pipe has a stop-cock at or near each of its ends, to be opened or closed as required and is fitted with flexible connections and couplings for connecting the pipes from car to car of a train so as to form a continuous line for the transmission of compressed air from a main reservoir supplied by an air pump on the engine. When the brakes are off or released, but in readiness for action upon the wheels of the train, the air which fills the main reservoir and main air pipes has a pressure of from sixty-five to seventy-five pounds

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1155 to the square inch, and, by reason of the connections referred to, the same pressure is exerted in the casings of the triple valves on both sides of their pistons and in the auxiliary reservoirs connected therewith. At the same time passages called release ports are open from the brake-cylinders, to the atmosphere. When it is desired to apply the brakes, air is allowed to escape from the main air pipes through the engineer's valve, thereby reducing the pressure in the main air pipes, whereupon the then higher pressure in the auxiliary

reservoirs moves the pistons of the triple valves, so as to first close the passages from the triple valves to the brake-pipe and at the same time close the release ports of all the brake-cylinders, and then open the passages from the auxiliary

^{to the brake-cylinders}

reservoirs, & the pistons of which are forced out by the

Insert com-

Jan. 19, '87. pressed air thereby admitted to the brake-cylinders, applying

the brakes by means of suitable levers and connections, all of which mechanism is fully shown in various letters patent granted to me.

The application of the brakes with their full force has heretofore required a discharge of air from the main pipe sufficient to reduce the pressure in said pipe below that remaining in the auxiliary reservoir after the brakes have been fully applied, and it has been found that while the brakes are sufficiently quick in action on comparatively short trains, their action on long trains of from thirty to fifty cars, which are common in freight service under present practice, is in a measure slow, particularly by reason of the fact that

^{required to be discharged from}

^{to set the brakes}

all the air & [in]* the main pipe & must travel from

Insert the rear of the

Feb. 5, '87. train to a single discharge opening on the engine. This dis-

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1156 charge of air at the engine has not only involved a serious loss of time in braking, but also a waste of air. Under my present invention a quicker and more efficient action of the brakes is obtained, and air which has been heretofore wasted in the application of the brakes is almost wholly utilized to act upon the brake pistons.

In the accompanying drawings: Figure 1, is an inverted plan view of a railroad car illustrating the application of my invention; Fig. 2, a longitudinal section, on an enlarged scale, through the triple valve, at the line *x, x*, of Fig. 4; Fig. 3, a transverse section through the same at the line *y, y*, of Fig. 2; Fig. 4, a bottom plan view of the cap or drain-cup of the triple valve; Fig. 5, a longitudinal section through the triple valve, at the lines *z, z*, of Fig. 3, and *w, w*, of Fig. 6; Fig. 6, a partial bottom view of the triple valve, and; Fig. 7, a longitudinal central section through the brake-cylinder and auxiliary reservoir, with the triple valve in elevation.

In the practice of my invention, each railroad car 1, on which it is applied, is as heretofore provided with a main air pipe 2, governed by stop-cocks 3, adjacent to its ends, and

[* Word enclosed in brackets erased in copy.]

having a flexible connection 4, and coupling 5, at each end to admit of being coupled to the main pipe of the tender or the adjacent car or cars of a train. An auxiliary reservoir 6, and brake-cylinder 7, are secured in convenient position below the sills of the car, the brake-cylinder having a piston 52, by the movement of which, through a system of lever connections which do not form part of my present invention, the brake-shoes 9, are applied to and released from the wheels

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1157 of the car, compressed air being supplied to and released from

the brake-cylinder 7, as the pressure in the main air pipe is reduced or reinstated respectively, by means of a triple valve 10, the casing or chest of which communicates with the main

5 air pipe, the auxiliary reservoir, and the brake-cylinder.

So far as the performance of its preliminary function in ordinary braking is concerned, that is to say, effecting the closure of communication between the main air pipe and the auxiliary reservoir, and the opening of communication between

10 the auxiliary reservoir and the brake-cylinder in applying the brakes, and the reverse operations in releasing the brakes, the triple valve 10, accords substantially with that set forth in letters patent of the United States No. 220,556, granted and issued to me October 14, 1879, and is not therefore, saving

15 as to the structural features by which it performs the further function of effecting the direct admission of air from the main air pipe to the brake-cylinder, as presently to be described, claimed as of my present invention. Certain of its elements devised and employed by me prior thereto, will however be herein specified in order to render its construction and operative relation to other members of the brake mechanism

20 fully intelligible.

Insert
Feb. 5, '87.

The case or chest in which the operative mechanism of the

25 triple valve 10, proper is mounted, is fixed ^{under or on} a [to]* the car body in any convenient position relatively to the auxiliary reservoir 6, and brake-cylinder 7, being, in this instance, shown as secured directly to one end of the auxiliary reservoir, in line axially therewith and with the brake-cylinder which is secured to its opposite end. The triple-valve case is fit-

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1158 ed at one end with a cylindrical sleeve or bushing 11, which is bored out truly and forms the chamber of a piston 12, which is fixed upon a stem 13, carrying, as in my letters patent No.

[* Word enclosed in brackets erased in copy.]

220,556 before mentioned, a slide-valve 14, which controls communication between the auxiliary reservoir and the brake-cylinder and between the brake-cylinder and release port 15, respectively. The auxiliary reservoir 6, is continuously in communication with the chamber 11, on one side of the piston 12, through the longitudinal chamber 24, of the case in which the slide-valve 14, moves, and the triple-valve case communicates, by a passage 16, with the brake-cylinder, and, by a passage 17, with the main air pipe 2. The passage 17, leading from the main air pipe, communicates, by a passage 18, with the cap, or, as it is ordinarily termed, the drain-cup, 19, of the triple valve, from which passages 20, lead into the piston chamber 11. A four-way cock 21, controls the passages 16, 17, 18, and a passage 22, leading to a port 23, in the face or seat of the slide-valve 14. When in the position shown in the drawings, communication is continuously maintained between the main air pipe 2, and piston chamber 11, through the passages 17 and 18, drain-cup 19, and passages 20, and by turning the cock 21, so as to establish communication between the passages 16 and 17, the triple valve and auxiliary reservoir will be cut out from the main air pipe, and the mechanism can be operated as a non-automatic brake, the admission of air under pressure to the main air pipe and brake-cylinder effecting, in such case, the application of the brakes. The entire brake mechanism of the car, other than the main air pipe, may be put out of action, when for any reason required, by turning

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1159 the cock 21, into position to cover the passages 16 and 18, the main air pipe then serving only for the transmission of air between the portions of the train line made up by the main air pipes of the remaining vehicles.

The slide-valve 14, is loosely connected with the stem 13, of the piston 12, and, by a pin 25, extending across the stem and fixed in the side plates of the valve, is prevented from being separated from the stem when removed for examination; it is held up to its seat in the chamber 24, by a spring 26. The valve partakes in the reciprocating movements of the stem 13, being moved in one or the other direction by a collar 27, and a shoulder 28, respectively, on the stem. Said collar and shoulder are located at a distance apart slightly greater than the length of the valve 14, so that a limited degree of traverse of the stem 13, and piston 12, in each direction is effected without imparting movement to the valve. A graduating valve 29, secured upon a stem 30, which is moved by the piston stem 13, governs a passage 31, in the slide-valve 14, said passage communicating, by a lateral port 32, with the valve chamber 24, and, consequently, with the auxiliary reservoir. A cavity or passage 33, is formed on the face of the slide-valve 14, of such length as to establish

communication during a portion of the traverse of the valve between the port 23, of the valve chamber 24, which is open
 25 to the passage 16, leading to the brake-cylinder, and a port 34, communicating with the relief port 15. The construction and relative arrangement of the piston stem 13, slide-valve 14, and graduating valve 29, are substantially similar to those of the corresponding parts as heretofore employed by me

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1160 and exemplified in my letters patent No. 220,556, but, under my present invention, these are supplemented by a port 35, leading from the end of the valve adjacent to the opening of the chamber 24, which communicates with the auxiliary reser-
 5 voir, to the face of the valve, so as, at the limit of traverse of the piston stem in the application of the brakes, to establish communication, directly through said passage, between the auxiliary reservoir and the port 23, and passages 22 and 16, leading to the brake-cylinder.

10 The piston stem 13, abuts, when the stem 13, and piston ^{for} Nov. 27, '86. 12, are moved [from]* the major portion of their traverse towards

the drain-cup 19, against a stem 36, which is fitted to slide freely in line axially with the stem 13, in an open-ended
 15 bushing 37, in the end of the drain-cup 19, adjoining the piston chamber 11, and in guide formed in a screw-cap 38, closing the opposite end of the drain-cup. A spring 39, surrounding the stem 36, and bearing against the inside of the cap 38, and against a collar 40, on the stem 36, maintains the
 20 latter in the position shown in Fig. 2, except when a sufficient pressure of air is admitted from the auxiliary reservoir to the piston chamber to overcome the resistance of the spring and effect movement of the piston 12, beyond the point at which its stem 13, comes in contact with the stem 36.

25 So far as hereinbefore described, the triple valve accords in all substantial particulars with and is adapted to operate similarly to those of my letters patent Nos. 168,359, 172,064, and 220,556, and, in order that it may perform the further functions requisite in the practice of my present invention, it is provided with certain additional members which

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1161 will now be described. For the purpose of effecting the admission of air directly from the main air pipe 2, to the brake-cylinder 7, when it is desired to apply the brakes with great
 5 rapidity and full force, an auxiliary slide-valve 41, is connected to and moves with the stem 36, said valve working over

[* Word enclosed in brackets erased in copy.]

a face in the bushing 37, between the piston chamber 11, and drain-cup 19, and governing a port 42, in said face, leading into a chamber 43, adjoining the same. The valve 41, has lateral wings or plates, fitting on each side of the stem 36, between shoulders or collars thereon, and is held thereto, when the stem is removed between collars or shoulders thereon abutting against its ends, by a pin 44, in its wings, a spring 45, acting to hold it to its seat in the bushing 37, when in position. The chamber 43, communicates, by a passage 46, (Fig. 5) with a chamber 47, in the end of the case of the triple valve adjacent to the auxiliary reservoir, from which chamber a passage 48, leads through the auxiliary reservoir into the brake-cylinder 7. The chamber 43, is further provided with a check-valve 49, which opens outwardly into and controls the passage of air into the passage 46, said valve being held to its seat by a light spring 50, and serving to prevent the return of air from the brake-cylinder when the pressure in the main air pipe is reduced below that in the brake-cylinder, as in the case of the separation of the cars of the train by the breaking of a coupling.

In the operation of the brake mechanism as above described, air from the main reservoir and main air pipe passes through the passages 17, 18, drain-cup 19, and passages 20, into the piston chamber 11, forcing the piston 12, to the left-

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1162 hand extremity of its stroke and uncovering a small feeding groove 51, in the piston chamber, through which air passes into the auxiliary reservoir 6, until the pressure in the latter is equal to that in the main air pipe, the brake-cylinder being meanwhile in communication with the atmosphere through the passages 16 and 22, valve cavity 33, and ports 23, 34, and release port 15. To apply the brakes in making ordinary stops, a portion of the air is discharged from the main air pipe by the engineers' valve, thereby correspondingly reducing the pressure in the main air pipe, whereupon the higher pressure in the auxiliary reservoir moves the piston 12, to the right, covering the feeding groove 51, and thus preventing the return of air from the auxiliary reservoir to the main air pipe, the movement of the piston continuing until arrested by the decrease of pressure in the auxiliary reservoir, or by the stem 36, and its spring 39. The movement of the slide-valve 14, then closes the port 23, preventing escape of air from the brake-cylinder, and places the passage 31, partly or wholly in communication with the port 33. The small auxiliary valve 29, having been meanwhile unseated, by the movement of the piston stem, compressed air from the auxiliary reservoir passes through the lateral port 32, and passage 31, of the slide-valve 14, and the passages 22, and 16, of the triple-valve case to the brake-cylinder, forcing out the piston, and,

- 25 through an appropriate system of levers and connections, applying the brakes. When the pressure in the auxiliary reservoir has in this operation, been reduced by expansion into the brake-cylinder until it is slightly below the pressure in the main air pipe, the pressure on the air-pipe side of the piston

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- 1163 12, forces the piston 12, in the opposite direction until the auxiliary valve 29, closes the passage 31, thereby arresting the further flow of air from the reservoir to the brake-cylinder and holding the brakes with a force proportionate to the
 5 reduction of pressure in the brake-pipe. To release the brakes, the pressure in the main air pipe is increased by admitting air from the main reservoir, whereupon the resultant increase of pressure in the piston chamber 11, forces the piston 12, back to its original or normal position, permitting
 10 the escape of air from the brake-cylinder 7, the piston 52, of which is returned to its position by a spring 53, releasing, in its backward movement, the brake-shoes 9, from the wheels, and at the same time the auxiliary reservoir is recharged. The admission of air to the brake-cylinder through
 15 the passage 31, which is opened just before the piston stem comes in contact with the graduating stem, and which corresponds to the feed-passage heretofore employed, suffices for the ordinary requirements of braking in regular service.

- In the event however of its becoming necessary to apply
 20 the brakes with great rapidity and with their greatest available force, the engineer, by means of the valve at his command instantly discharges sufficient air from the front end of the main air pipe, to effect a sudden reduction of pressure of about twenty pounds per square inch therein, whereupon the
 25 piston 12, of the triple valve is forced to the extreme limit of its stroke in the direction of the drain-cup 19, carrying with it the stem 36, and auxiliary slide-valve 41, which instantly uncovers the port 42, and discharges air from the main air pipe through the opening of the check-valve 49, and the

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- 1164 passages 46 and 48, to the brake-cylinder, and each car being provided with one of these devices, it will be seen that they are successively moved with great rapidity, there being practically, on a train of fifty cars, fifty openings for dis-
 5 charging compressed air from the main pipe instead of the single opening heretofore commonly used. Not only is there a passage of considerable size opened from the brake-pipe on each car, whereby the pressure is more quickly reduced, but the air so discharged is utilized in the performance of pre-
 10 liminary work, it being found in practice that the air so taken from the pipe will exert a pressure of about twenty-five

pounds in the brake-cylinders. When the piston 12, arrives at the extremity of its stroke, as above specified, the supplemental port 35, of the slide-valve 14, is brought into communication with the port 33, and passages 22 and 16, which serves to discharge the reservoir pressure into the brake-cylinder, thereby augmenting the pressure already exerted in the brake-cylinder by the air admitted from the main air pipe. Upon the reduction of the pressure in the main air pipe below that in the brake-cylinders, as by the breaking in two of the train, the check-valve 49, closes communication between the passages 46 and 18, thereby preventing the return of the air from the brake-cylinder to the main air pipe. The feed-opening for the admission of air from the auxiliary reservoir to the brake-cylinder is purposely made of comparatively small diameter, it having been determined by experiment that the initial application of the brakes should not be made with maximum force, and this opening may be made of such size as to apply the brakes exactly in accord with the requirements of the

12

1165 most efficient work.

In using the terms "triple valve" and "triple-valve device," I refer to a valve device, however specifically constructed, having a connection with the main air or brake pipe, another with an auxiliary reservoir or chamber for the storage of power, and another with a brake-cylinder or its equivalent for the utilization of the stored power and with a release or discharge passage for releasing the operative power from the brake-cylinder, whether the valves governing these passages or connections are arranged in one or more cases and are moved by a piston or its equivalent or by a series of pistons or their equivalents, there being numerous examples in the art of constructions varying materially in appearance whereby these functions are performed, both in plenum and vacuum brake mechanisms.

While I have herein described my invention as applied in a brake mechanism utilizing air under pressure, such as is in general and approved use, I do not desire to limit myself to brakes so operated, as my improvements are likewise susceptible of application, without variation of principle, in connection with brakes worked by atmospheric pressure.

Substitute B.
Jan. 20, '87.

25

Further, while in the specific construction described and shown, the function of admitting air from the main pipe is performed by a valve separate from that which effects the preliminary admission of reservoir pressure to the cylinder, a modification in which the same office is performed by a valve integral with the main valve and formed by an extension thereof, would be included in and embody the essential operative features of my invention.

13

1166 I claim as my invention and desire to secure by letters patent:

Substitute A.
Jan. 19, '87.

5

1. In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake-cylinder, and a triple valve provided with a device for admitting air directly from the main air pipe to the brake-cylinder, substantially as set forth.

2. In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake-cylinder, and a triple valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake-cylinder and which by a further traverse, admits air directly from the main air pipe to the brake-cylinder, substantially as set forth.

3. In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake-cylinder and a triple valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake-cylinder and which, by a further traverse, admits air directly from the main air pipe to the brake-cylinder and effects a second admission of air from the auxiliary reservoir to the brake-cylinder, substantially as set forth.

[Matter enclosed between rules erased in copy.]

4. The combination, in triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber

14

1167 therein, a valve moving with the piston stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake cylinder and to the atmosphere respectively, and an auxiliary valve actuated by the piston stem and controlling communication between passages leading to connections with a main air pipe and with the brake-cylinder respectively, substantially as set forth. 5

5. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere respectively, an auxiliary valve actuated by the piston stem and controlling communication between passages leading to connections with a main air pipe and with the brake-cylinder respectively, and a check or non-return valve interposed between the auxiliary valve and the passage leading therefrom to the brake-cylinder, substantially as set forth. 10 15

6. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere respectively, an auxiliary stem mounted in the cap of the case in position to be moved longitudinally by the piston stem in the latter portion of its traverse in the direction required 20 25

15

1168 for the application of the brakes, a spring bearing against a collar on the auxiliary stem and against a fixed abutment, and an auxiliary valve connected to the auxiliary stem and controlling communication between passages leading to connections with a main air pipe and with the brake-cylinder respectively, substantially as set forth. 5

7. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, an auxiliary valve actuated by the piston-stem and controlling communication between passages leading to connections with a main air pipe and with a brake-cylinder respectively, and a main valve connected to the piston-stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere respectively, said main valve having a supplemental port or passage which establishes communication between 10 15

the auxiliary reservoir and brake-cylinder connections at or near the limit of the traverse of the main valve in effecting

1169 the application of the brake under maximum pressure, substantially

as set forth.

In testimony whereof, I have hereunto set my hand.

GEO. WESTINGHOUSE, JR.

Witnesses:

J. SNOWDEN BELL.

R. H. WHITTLESEY.

1170 STATE OF PENNSYLVANIA, } ss :
County of Allegheny,

George Westinghouse, Jr., the above-named petitioner, resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, a citizen of the United States, being duly sworn deposes and says that he verily believes himself to be the original, first, and sole inventor of the improvements in fluid-pressure automatic brake mechanism described and claimed in the foregoing specification; that the same have not been patented to him, or to others with his knowledge or consent in any country, that the same have not to his knowledge been in public use or on sale in the United States for more than two years prior to this application, and he does not know and does not believe that the same were ever known or used prior to his invention thereof.

GEO. WESTINGHOUSE, JR.

Sworn to and subscribed before me this seventeenth day of November 1886.

[SEAL.]

R. H. WHITTLESEY,
Notary Public.

1171 In the United States Patent Office.

In the matter of the application of George Westinghouse, Jr. Improvement in fluid-pressure automatic brake mechanism. Filed Nov. 19, 1886. Serial No., 219,353.

Before the examiner. Room 38.

PITTSBURGH, Nov. 26th, 1886.

Hon. Commissioner of Patents.

SIR: I hereby amend the specification by cancel-
 1/ ling the word "from," line 11, p. 8, and substituting "for."
 Respectfully, J. SNOWDEN BELL, *Attorney.*

1172

DEPARTMENT OF THE INTERIOR,
 UNITED STATES PATENT OFFICE,
 WASHINGTON, D. C., Jan. 14th, 1887.
 Mailed " " "

No. 219,353. Fluid-pressure automatic brake. Filed Nov. 19th, 1886.

George Westinghouse, Jr., care J. Snowden Bell, Pittsburgh, Pa.:

Claims 1 & 2 are anticipated by patent No. 280,285 to G. A. Boyden, June 26th, 1883 (steam & air brake attachments).

It is desirable that a working model of the triple valve be furnished.

F. FOWLER, *Ex.*

T. J. HOGAN.

1173 In the United States Patent Office.

In the matter of the appl'n of George West-
 inghouse, Jr., for imp't in fluid-pressure } Before the Examiner.
 automatic brake mechanism. Filed Nov. } Room 38.
 19, 1886. Se. No., 219,353.

WASHINGTON, D. C., Jan. 19th, 1887.

Hon. Commissioner of Patents.

SIR: Acknowledging the official letter of 14th inst.
 I hereby amend the specification as follows, to wit:

1/ In line 14, page 3, after "reservoirs," insert: "to
the brake cylinders."

Cancel the comma after "air," line 15, page 3.

1/ Cancel claim 1, and substitute:

"1. In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake-cylinder, a triple valve, and an auxiliary valve device, actuated by the piston of

- A. the triple valve, and independent of the main valve therefor admitting air, in the application of the brake, directly from the main air pipe to the brake-cylinder, substantially as set forth

It is respectfully submitted that while the Boyden patent No. 280,285 referred to, shows what the inventor terms "an always-open one-way passage" by which communication may be estab-

- lished under certain conditions between the main air pipe and train-pipe, and hence might be held to meet the terms of the claim as originally broadly drawn, yet it fails to embody a device which in structure or function corresponds with the auxiliary valve of applicant, which in no sense relates to "an always-open one-way passage."

The amended claim above submitted prescribes a valve device actuated by the piston of the triple valve for admitting air to the brake-cylinder in the application of the brake, while Boyden's check-valve *d*, is not actuated by the piston, and is designed to recharge the auxiliary reservoir and brake-cylinder while the brakes are on.

It is submitted as to claim 2, that a piston which by its preliminary traverse admits air from the auxiliary reservoir to the brake cylinder and by its further traverse admits air directly from the main air pipe to the brake-cylinder, as set forth in said claim, is not found in the Boyden patent, the check-valve *d*, of which is described as actuated by the manipulation of the cock *g*, on the locomotive "to recharge and continue charging the reservoir and brake-cylinder while the brakes are applied." (Boyden patent, lines 56-69, page 2.)

Further, it will be observed that the space between the lower end of Boyden's piston *G* and the port in the left-hand side thereof governing the passage *D*, is equal to the width of the face of the upper end of the slide-valve *H*, so that the admission will be coincident through the passages *C'* and *D*, thus evidencing that both ^{are} *A* opened by the preliminary traverse of the piston.

It is to be understood that applicant does not seek to broadly claim a device for admitting air directly from the main air pipe to the brake-cylinder, as the four-way cock long heretofore employed by him (similar to the cock *K* of the Boyden patent)

would be a structure of such character. When however the triple valve is provided with an auxiliary valve operated by its piston which performs a new function additional to that of the triple valve as previously employed, it is believed that such combination is wholly novel.

With reference to the Boyden invention as shown in figure 2, it will be noticed that the upper piston 1, is intended to be acted upon by the pressure in the chamber above it in applying the brakes, and that the pressure in this chamber is supposed

to be maintained at a constant point after the air within it has expanded. Practice has shown that it is utterly impossible to pack a piston or device such as illustrated so that the valve constructed as shown would be an impracticable device. Boyden had no idea of quickly applying his brakes, and has provided no means whereby the brakes can be applied with a moderate amount of force, as is fully provided for by applicant and Boyden's construction involves the full application of the brakes in all cases, which would render the device inoperative for the obvious requirements of railway service.

He seems to have conceived the idea of charging the brake-cylinder and reservoir when the brakes are on, assuming that the pressure in the brake-cylinder and reservoir might leak away, and might, therefore, need replenishing.

The check-valve *d*, is provided with a spring tending to hold it to its seat. If this spring were made with considerable tension, the piston and slide-valve would be forced up to the position shown in the drawing without the possibility of applying more pressure to the brake-piston. If, on the contrary, the valve

1176 *d* is made so that the resistance to the passage of air is less than,

the resistance of the piston, the reservoir and brake-cylinder will be charged and the release of the brakes will be prevented unless the chamber *L* is made of nearly the same proportion as the auxiliary reservoir.

In the Boyden invention, to apply the brakes with full force requires the discharge of the greater portion of the air from the brake-pipe, after which he proposes to further increase the pressure in the brake-cylinder by allowing air to pass the valve *d*. If he were to attempt to apply the brakes with a moderate amount of force, the piston and slide-valve would descend admitting some air to the brake-cylinder, and would be released unless the piston *I* were to be made air-tight.

The recharging of the auxiliary reservoir where the ordinary Westinghouse triple valve is used, requires only a small passage through or by the piston. The feed-groove, which is shown in the cylinder, could be extended to a point reaching below the piston when the triple valve is in its middle position, that is, in the position to prevent air from passing either from the reservoir to the brake-cylinder, or from the brake-cylinder to the atmosphere. This feed-groove would allow the air to pass around the piston and recharge the reservoir. Experiments of this kind have been repeatedly made, but the difficulties arising from the inability to release the brake prevent the use of such a construction.

A model is filed herewith as suggested by the office.

Reconsideration upon the above points and amendment is requested.

Respectfully,

J. SNOWDEN BELL,
Att'y for Applicant.

1177 In the United States Patent Office.

In the matter of the appl'n of George Westinghouse, }
Jr., for imp't in fluid-pressure automatic brake mech- } Room 38.
anism. Filed Nov. 19, 1886. Se. No., 219,353.

WASHINGTON, D. C., Jan. 19th, 1887.

Hon. Commissioner of Patents.

SIR: In further acknowledgement of the official letter of 14th inst, I hereby amend the specification as follows: to wit,

Cancel all between the word "Further," line 21, page 13, and "invention," line 29, same page, both inclusive, and substitute:

- B. "I am aware that a construction in which 'an always open one-way passage' from the main air pipe to the brake-cylinder is uncovered by the piston of the triple valve simultaneously with the opening of the passage from the auxiliary reservoir to the brake-cylinder, has been heretofore proposed, and such construction, which involves an operation different from that of my invention, I therefore hereby disclaim."

Respectfully,

J. SNOWDEN BELL,
Attorney for Applicant.

1178

DEPARTMENT OF THE INTERIOR,
U. S. PATENT OFFICE,
WASHINGTON, D. C., Jan. 31, 1887.

Petition.

Application of Geo. Westinghouse, Jr. Serial No., 219,353. Invention: Fluid-pressure automatic brake mechanism.

This petition is referred to the examiner in charge of division 18 for recommendation.

In case he recommend adversely he will state his reasons therefor.

M. V. MONTGOMERY,
Commissioner.

1179 & 1180 *Memorandum of Fee Paid at U. S. Patent Office.*

Serial No., 219,353. — —, 188—.

Inventor:
George Westinghouse, Jr.

Patent to be issued to—
— —.

Name of invention, as allowed:
Fluid-pressure automatic brake mechanism.

Date of payment:
— —, —.

Fee:
\$20.

Solicitor:
J. Snowden Bell.

Date of filing:
Nov. 19, 1886.

Date of circular of allowance:
Jan'y 22, 1887.

Send patent to—
George H. Christy, box 1034, Pittsburgh, Pa.

1181 In the United States Patent Office.

In the matter of the application of George Westinghouse, Jr. Improvement in fluid-pressure automatic brake mechanism. Filed Nov. 19th, 1886. 188—. Serial No., 219,353.

Before the examiner. Room 38.

PITTSBURGH, Jan. 29th, 1887.

Hon. Commissioner of Patents.

SIR: I hereby request that the following amendments, relating to minor inaccuracies of statement and not affecting the merits, may be made in the specification, in accordance with the provisions of rule 77, to wit:

Cancel the word "in," line 28, page 3 and substitute

✓ the words "required to be discharged from"

In same line after "pipe" insert: "to set the brakes"

Cancel the word "t" line 24, page 5, and substitute

✓ "under or on"

Respectfully, J. SNOWDEN BELL, *Attorney.*

Recommended that above request be granted.

T. FOWLER, *Ex.*

Approved.

M. V. MONTGOMERY, *Commissioner.*

Feb. 4, '87.

91—403

1886.

Div. 18.

Patent No. 360,070.

George Westinghouse, Jr.,

Of Pittsburgh,

County of —,

State of Pennsylvania.

Invention: Fluid-pressure automatic brake mechanism.

Parts of applica- tion filed.	{	Petition,	Nov. 19, 1886.
		Affidavit,	" " "
		Specification,	" " "
		Drawing, 3 sh'ts,	" " "
		Model, January 19th, 1887.	
		Specimen, —,	
		First fee, cash, \$15, Nov. 19, 1886.	
		" " cert., —.	

App. filed complete Nov. 19, 1886.

Examined Jan. 20, '87. F. Fowler, ex.

Countersigned: T. W. Dick Bullock, for Commissioner.

Jan. 21, '87.

Notice of allowance, Jan. 22nd, 1887.

Final fee, cash, \$20, Mar. 3, 1887.

" " cert., — —, 188—.

Patented Mar. 29, 1887.

Att'y, or P. O. address: J. Snowden Bell, Pittsburgh, Pa.

1183 & 1184

(2-024.)

Serial No., 219,353.

Issue division.

All communications should be addressed to "The Commissioner of Patents, Washington, D. C."

DEPARTMENT OF THE INTERIOR,

U. S. PATENT OFFICE,

WASHINGTON, D. C., Jan. 22, 1887.

George Westinghouse, Jr., c. o. J. S. Bell, Pittsburg, Pa.

SIR: Your application for a patent for an improvement in fluid-pressure automatic brake mechanism, filed Nov. 19th, 1886, has been examined and allowed.

The final fee, twenty dollars, must be paid, and the letters patent bear date as of a day not later than six months from the time of this present notice of allowance.

If the final fee is not paid within that period the patent will be withheld, and your only relief will be by a renewal of the application, with additional fees, under the provisions of section 4897, Revised Statutes. The office aims to deliver patents upon the day of their date, and on which their term begins to run; but to do this properly applicants will be expected to pay their final fee at least twenty days prior to the conclusion of the six months allowed them

by law. The printing, photolithographing, and engrossing of the several patent parts, preparatory to final signing and sealing, will consume the intervening time, and such work will not be done until after payment of the necessary fees.

When you send the final fee you will also send, distinctly and plainly written, the name of the inventor and title of invention as above given, date of allowance (which is the date of this circular), date of filing, and, if assigned, the names of the assignees.

If you desire to have the patent issue to assignees, an assignment containing a request to that effect, together with the fee for recording the same, must be filed in this office on or before the date of payment of final fee.

Additional copies of specifications and drawings will be charged for at the following rates: Single copies, uncertified, 25 cents; twenty copies or more, 10 cents each. The money should accompany the order.


Very respectfully,

M. V. MONTGOMERY,

C. E. MITCHELL,

Commissioner of Patents.

[Printed on the margin:] The within title is that given by the examiner in charge as most appropriate to your invention. Should you desire a change in the same, satisfactory reasons must be given therefor on or before the payment of the final fee.

[Printed across the face:]  In remitting the final fee give the serial number at the head of this notice.

1185 121. Steam engines,
Steam & air brakes.

1886.

Contents.

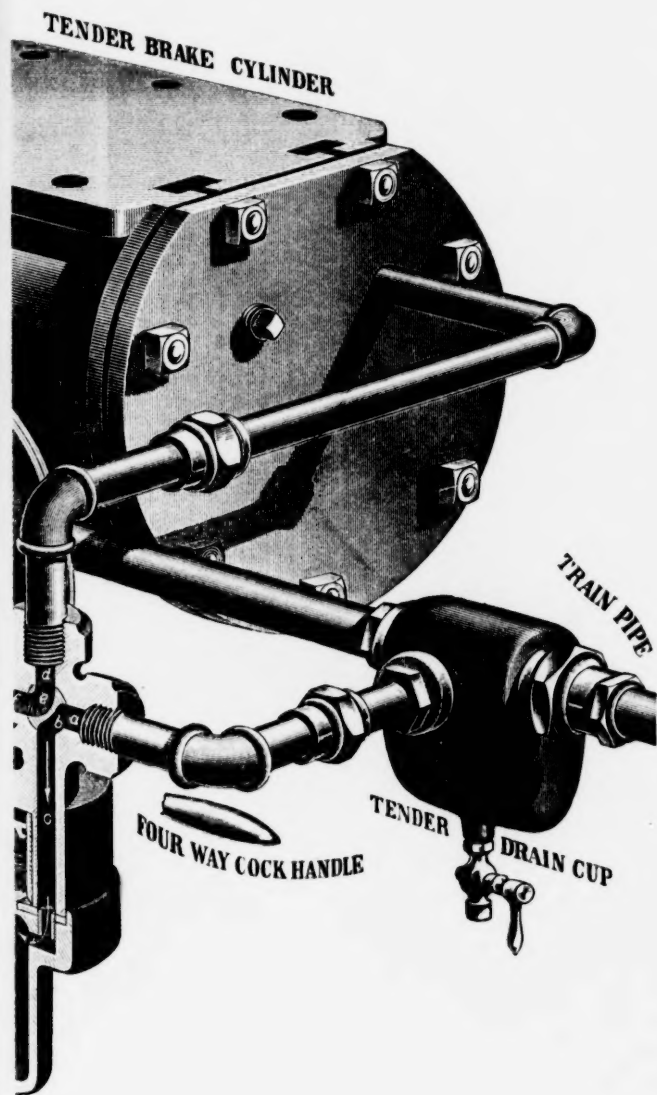
G.

1. Application, 1 papers.
1. Amend't, Nov. 27, '86.
2. Rej., Jan. 14th, 1887.
3. Amend't A, Jan. 19, '87.
4. Amend't B, Jan. 20, '87.
5. Request, Jan. 31st, 1887.
6. Amend't (under rule 77), Feb. 5, '87.
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- 18.
- 19.
- 20.

Title: Improvement in fluid-pressure
automatic brake
mechanism.

J. F. F.
M. H.

1186 (Here follows diagram marked pp. 1187 & 1188.)



FOLDOUTS TOO LARGE TO
BE FILMED

1189-1191 *Extracts from "Defendants' Exhibit Westinghouse 1886 Instruction Book."*

From page 3.

Our attention has been repeatedly directed to the importance of furnishing a complete and concise description of our brake apparatus, to be placed in the hands of those who are engaged in its operation or its maintenance. In the present book we have illustrated the general construction of the brake and all the more essential parts.

From page 7.

Too much importance cannot be attached to that portion of the instructions stating that engineers should use care and moderation in applying the brakes for ordinary stops. By applying them at a fair distance from the station, with moderate force, the train is stopped gently and without inconvenience to the passengers, while if they are thrown on with the utmost force possible, the train is jerked in a manner that is extremely disagreeable to the passengers.

Extract from "Defendants' Exhibit Westinghouse 1890 Instruction Book."

From page 19.

The plain automatic triple valve.

A perspective view of the plain automatic triple valve and locomotive-tender brake apparatus, is shown in plate 1, Fig. 3, and cross-sections of the triple valve in Figs. 4 and 4a, which will clearly show its construction. It is desirable that this triple valve be perpetuated for use with locomotive driving-wheel and tender brakes, to give a slightly slower action to the brakes thereon in cases of emergency action of the quick-action apparatus on cars.

The construction and operation of the plain automatic triple valve is substantially the same as that of the quick-action form, the quick-action valves being omitted, and pressure used only from the auxiliary reservoir in applying the brakes, and will not, therefore, require specific description.

1193

UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., of Schenectady, New York.

Improvement in Steam-power Brake Devices.

Specification forming part of Letters Patent No. 88929, dated April 13, 1869.

To all whom it may concern :

Be it known that I, George Westinghouse, Jr., of Schenectady, in the county of Schenectady and State of New York, have invented a new and useful improvement in power car-brakes ; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawing, making a part of this specification, in which—

(Here follows diagram marked p. 1192.)

Figure 1 shows by a side elevation, partly in section, my improvement as mounted on and applied to an ordinary platform railroad-car. Fig. 2 is a sectional plan view as formed by a horizontal plane passing through the brake-cylinder, just below the body of the car. Fig. 3 is a vertical, and Fig. 4 is a cross section of the three-way cock by which I admit or cut off the supply of air to the brake. Fig. 5 is an outside view, and Fig. 6 is a longitudinal section of my improved coupling for uniting the brake-pipes of contiguous cars.

Like letters represent like parts of each.

My invention relates to the construction of a power car-brake for railway-cars or other like vehicles, to be operated by compressed air or other elastic compressible fluid ; and the nature of it consists, first, in the use of an auxiliary engine for compressing the air in a reservoir, from which it is to be conducted by suitable pipes and applied to operating the brakes, and also for pumping feed-water into the boiler, either or both ; second, in the construction of a reservoir for storing up the power to be derived from air or other elastic fluid under compression, such reservoir having a pipe or pipes leading to one or more brake-cylinders on or attached to each car, with a valve or cock in each pipe for turning on or off the supply of air ; third, in the construction and combination of devices by which the power thus communicated to the piston of the brake-cylinder may be from it applied to operating an ordinary hand-brake, or any other known form of simple or compound brake ; fourth, in the construction of an improved coupling for uniting the brake-pipe of contiguous cars, so made that when coupled they shall be always open for the passage of air to the brake-cylinders, but if uncoupled, when the brakes are down, the pressure of the air in the pipes will instantly close them.

To enable those skilled in the art to make and use my invention, I will proceed to describe its construction and manner of use.

No. 1403 & 426.
 Westinghouse Co. } p. 1192
 Dayton Co.

G. WESTINGHOUSE, Jr.
 STEAM POWER BRAKE.

No. 88,929.

Patented Apr. 13, 1869.

Fig. 1.

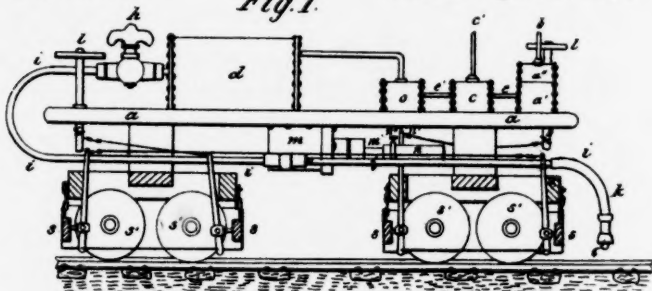


Fig. 2.

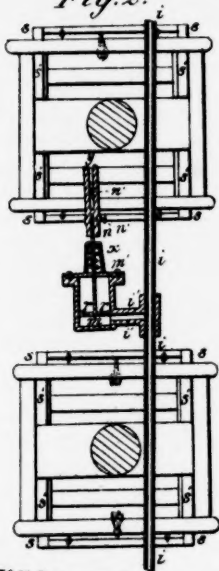


Fig. 3.



Fig. 4.



Fig. 5.

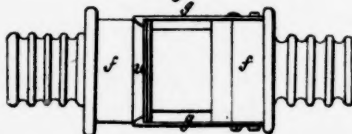
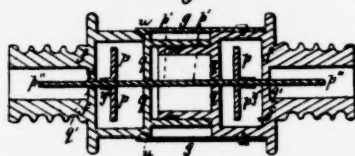


Fig. 6.



Witnesses
 Thos. B. New
 R. C. Marshall

Inventor
 George Westinghouse, Jr.
 by Bakewell & Christy
 his Attys.



a represents a platform-car on which is mounted an auxiliary engine, *a' a''*, a feed-water-pumping cylinder, *c*, and an air-pump, *o*, and an air-reservoir, *d*. A single piston-rod connection, *e e'*, may answer for both pumps; or one piston-rod may lead from the auxiliary engine *a' a''* to the feed-water pump *c*, and another to the air-pump *o*. In either case the operation would be the same. *b* is a steam-pipe leading from the locomotive-boiler to the auxiliary engine *a' a''*. A water-pipe extends from the water-tank on the tender to the pumping-cylinder *c*, and by a piston working therein, water is fed through the pipe *c'* to the boiler. The air-pump *o* has the usual valves, and works on the principle of the ordinary air-pump, and compresses the air into the reservoir *d*. Each of these cylinders is fitted with the valves and cocks necessary to their successful operation.

From the reservoir *d* an air-pipe, *i*, leads down and back along under the cars of the train, the communication through the pipe being opened and closed by a three-way cock, *h*, presently to be described.

At any convenient point on or under each car a brake-cylinder, *m*, is attached, having a piston working closely therein. A pipe, *i'*, leads from the main pipe *i* to each brake-cylinder *m*, opening into it back of the piston *r*. The piston-stem *m'* plays through the opposite end of the brake-cylinder *m*, and at its outer end may be bifurcated, so as to operate against the brake-lever *n'*; or an adjustable bifurcated head, *n*, may be set thereon by a set-screw *n''*. The brake-lever *n'* and the brakes connected therewith may be simple or compound, or of any known or desirable construction. As shown, they are of the ordinary style. It will be observed that, with the construction and arrangement shown, the operation of the "doctor" or feed-water pump, and of the brakes, is in no way dependent on the movements of the locomotive. If steam be up, water can be fed into the boiler, even when the locomotive is standing, which end

is a desirable one, since it is sometimes far from convenient
1194 to run a locomotive and train forward or back merely to

replenish the supply of water in the boiler, and still more so at other times to slack up a train for the same purpose. In like manner, the operation of the auxiliary engine *a' a''* may be so regulated, even with the locomotive running at its highest speed, and with an occasional or even frequent application of the brakes, that a uniformly constant pressure of air can be preserved in the reservoir *d*. This auxiliary engine *a' a''*, with the pumps *c o* and reservoir *d*, may, and probably should be for convenience, mounted on or attached in some way to the locomotive or tender. As they are small, light, and not costly, they can be easily and cheaply applied. If it be desired to operate either alone, the connecting-valves of the other may be closed, and its piston work *in vacuo*, without in the least interfering with the working of the other.

The reservoir *d* being filled with compressed air, whenever it is desirable to apply the brakes the cock *h* is turned, and the air rushes along, through the pipes *i i'*, into the brake-cylinder *m*, forces its rod *m'* against the brake-lever *n'*, whereby the brakes *s* are instan-

taneously applied to the wheels s' , and the speed of the train at once checked. Of course, the more the air is compressed in the reservoir d , the more powerful will be its action on the brakes.

The cock h is a three-way cock—that is, it opens on three sides. When turned as in Fig. 4, the air flows freely through from the reservoir d , as described. On being turned one-quarter way around the orifice z comes into the tubular opening of the pipe i , leading to the brakes, and the orifice z' coincides with the orifice in the side of the valve-seat, so that communication is cut off from the reservoir d to the brakes, but opened from the brake-cylinders to the external atmosphere. The excess of air then escapes. The spiral spring x , Fig. 2, carries the piston r of the brake-cylinder m back to the head of the brake-cylinder, and the brakes are off. The length of throw to be given to the brake-lever n' may sometimes vary somewhat, and hence I use the adjustable head n . The bifurcation y , whether made in the head n or in the stem m' , is of such depth that if it be sometimes preferred to operate the brakes by hand, the levers n' will not be drawn out of the fork or slot of the bifurcated end; and to illustrate such use I have shown the ordinary hand-brakes l attached.

To provide for longitudinal motion of the cars independent of each other in starting or stopping, I use between each two cars a section of air-tight flexible pipe, k , made of india-rubber, or india-rubber and cloth, or other like flexible and air-tight material.

An important feature of my invention consists of the construction and combination of coupling-valves, which I use in the ends f of the pipe k , where they are jointed between cars. These valves are more perfectly illustrated in Fig. 6, where $f f$ represent the adjacent or coupling ends of the pipes k of two consecutive cars. The end f couple one into the other, and hooks g pass over the beveled shoulders u in the face of the coupling f , and prevent their coming uncoupled, except in case the car-coupling should break, or a car jump from the track, and then the hooks g would be disengaged and the coupling be uncoupled from each other. Inside each coupling f is a puppet-valve, p , having a stem, p' , playing through a guide or diaphragm, q , the two stems being of such length that when the couplings f are coupled together the stems will come together end to end, and each force back the other, so as to throw its valve p free from its seat, and make an uninterrupted communication through the pipe i from the reservoir d to the last valve of the last car. The rear stems p'' play through guides or diaphragms q' , and keep the valves p more carefully centered, so that the forward stem p' will always engage each other when the cars are coupled. The guides $q q'$ should be open, or have openings, to admit of the passage from one pipe to the next of the compressed air. Then, when the pipes are uncoupled by the breaking of the car-coupling, or by a car leaving the track, the compressed air having been applied to the brakes, its pressure will cause the valves p to come against their seat on the guides q , thereby closing the ends of the pipe and keeping the brakes on or down. Thus the danger from accident will be materially decreased. The stems p'' are made with shoulders y'

which rest against the guides $q' p'$ when the ends f are coupled and the valves p are opened. Consequently the valves p cannot set back against the guides q' to close them, nor can the compressed air, when admitted, close the valves p or either of them. When the pipes are coupled, the valves p must always be open. If they come uncoupled when filled with compressed air, they will be instantly closed, and must necessarily remain so. Hence, in the worst of disasters, the brakes will remain down if once applied.

Instead of the puppet-valves p , other forms of valves may be used, provided they be so arranged as to operate or open each other when the pipes f are coupled together. For this purpose flap-valves with stems may be used; also, instead of the diaphragms for guiding the stems, wings on the stems may be substituted. In that case the wings may be so made as to slide in the cylindrical or other shaped cavity of the couplings f .

The hooks g operate with sufficient rigidity to catch tightly in the grooves u , and hold the couplings f together against any ordinary force exerted longitudinally to which they would be subject; but by beveling slightly the holding shoulder of the grooves u , as shown, the hooks g would be disengaged, as in case of an accident, by any force sufficient to throw the car from the track or by the breaking of the car-coupling. In lieu of this device, however, other devices performing the same function may be substituted—that is, other means may be used to accomplish the same end, provided they be such as will hold the couplings f together against the operation of any force to which in use they are ordinarily subject, but not such as to prevent their being automatically uncoupled in case of accident. At the same time all such devices should be so made that the couplings may be readily uncoupled by hand.

The particular advantages connected with the apparatus described, in addition to those above referred to, are, that the brakes are under the control of the engineer, and can be instantaneously applied at any time, and with any degree of power within the strength of the machinery employed, and the brakes can be as instantaneously loosened. They are simple in construction, cheaply made, and can be applied to and used in connection with or used without the ordinary hand-brakes. By the use of the auxiliary engine the operation of the brakes is made independent of the operation of the locomotive, so that much or little power can be stored up in the reservoir d at any time, whether the locomotive be running fast or slow, or not at all; and, if desired, all the force of the air-pump can be applied to the brakes over and above the force that can be stored up in the reservoir. By this mode of operating brakes in connection with the couplings described, in case of accident the brakes may be instantaneously applied, and kept "on" till the whole train, or each separate car, if the car-couplings break, be brought to a complete stand.

What I claim as my invention, and desire to secure by letters patent, is—

1. The auxiliary engine, with connections to, and in combination

with, the air-pump, air-reservoir, and brake-cylinder, substantially as hereinbefore set forth.

2. The auxiliary engine arranged to operate in connection with a railroad-locomotive, feed and water pumps, substantially in the manner hereinbefore set forth.

3. The reservoir *d*, with pipes *i*, leading to one or more brake-cylinders on, or attached to, each car, with a valve or cock in each pipe for turning on or off the supply of air, arranged substantially as above set forth.

4. The brake-cylinder *m*, in combination with the pipe *i'*, and piston-stem connecting with the brake-lever, substantially as hereinbefore set forth.

5. The adjustable head *n* on the piston-stem *m'*, in connection with the brake-lever *n'*, substantially as hereinbefore set forth.

6. The valves *p*, arranged in the adjacent ends of the couplings *f*, and so guided by stems and guides or diaphragms as to operate to open each other when the couplings *f* are united, and automatically to close when forcibly uncoupled, substantially as above set forth.

In testimony whereof I, the said George Westinghouse, Jr., have hereunto set my hand.

GEO. WESTINGHOUSE, JR.

Witnesses:

A. S. NICHOLSON.

G. H. CHRISTY.

No. 403 x 126.
 Westinghouse } p. 1198
 Doyle & Co.

GEORGE WESTINGHOUSE, Jr.
 Improvement in Steam Power Air Brakes and Signals.
 No. 124,404. Patented March 5, 1872.

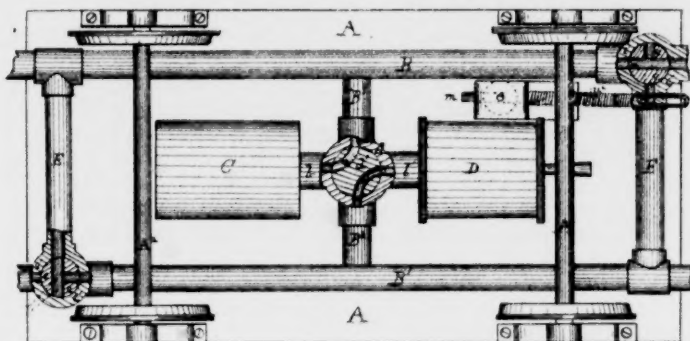


Fig. 1.

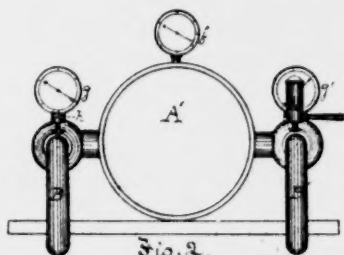


Fig. 2.

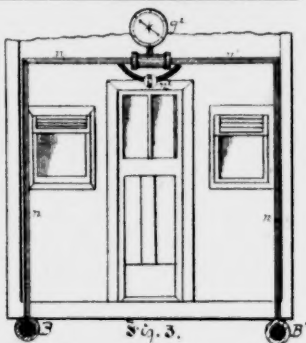


Fig. 3.



Fig. 4.

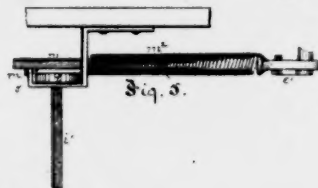


Fig. 5.

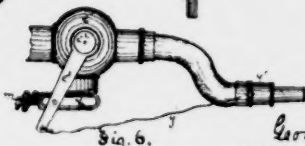


Fig. 6.

Witnesses:
 James I. Kay
 & C. Titler

Inventor:
 George Westinghouse
 by Bakewell, Christy & Kerr,
 his Attys.

1199 UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., of Pittsburg, Pennsylvania.

Improvement in Steam-power Air-brakes and Signals.

Specification forming part of Letters Patent No. 124,404, dated March 5, 1872.

Specification.

To all whom it may concern :

Be it known that I, George Westinghouse, Jr., of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful improvement in steam-power air-brakes and signal: and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawing making a part of this specification, in which—

(Here follows diagram marked p. 1198.)

Figure 1 is an inverted view of a car-body with my improved apparatus attached thereto. Fig. 2 shows the arrangement of the air-brake pipes with reference to the main reservoir. Fig. 3, in connection with Fig. 2, illustrates the use of the apparatus for signaling. Fig. 4 is an enlarged view of the gauge-index, and Figs. 5 and 6 are enlarged and detached views of the tripping apparatus of Fig. 1.

Like letters of reference indicate like parts in each.

In the steam-power air-brake apparatus heretofore in use a single line of pipe conveys the compressed air from the main reservoir on the locomotive to each brake-cylinder. If this pipe becomes accidentally broken at any point it is, of course, useless for braking purposes from that point to the rear end of the train. For this and other reasons I have devised an apparatus consisting in part of a double line of brake-pipes, which may be co-operative or independently operative in braking at the pleasure of the engineer, and which as a separate device I have included in a separate application.

The improvement herein described relates to the same class of apparatus; and consists in the features of construction and combination, substantially as hereinafter claimed, by which, first, an air-reservoir, auxiliary to or independent of the main reservoir, is combined on each car with the brake-cylinder; second, by means of a cock or cocks, with suitable ports, such additional reservoir, when used as an auxiliary reservoir, is charged with compressed air from one brake-pipe, and the brake-cylinder from the other, such pipes in such use being interchangeable or not, at pleasure; third, and by means of a single cock with suitable ports either brake-pipe may be used for charging the reservoir and the other for operating

the brakes; fourth, when a car becomes disconnected from the train by accident or otherwise, a port or ports will thereby be opened in a communicating pipe or pipes, by which the air from such auxiliary reservoir will be admitted freely to the brake-cylinder, so as automatically to apply the brakes; and fifth, the conductor and engineer may communicate signals or orders to each other by the use of the brake-pipes and the compressed air.

Some of the functions above specified are performed by the apparatus described in the separate application above mentioned; and hence in such cases I limit myself in this application to the means set forth or their substantial equivalents.

To enable others skilled in the art to make and use my improvement, I will proceed to describe its construction and mode of operation.

The brake-pipes $B\ B^1$ extend along under the body of each car A from end to end, and the pipes of one car are coupled to those of the next by the hose and coupling connections described in patent granted to me August 8, 1870, and thereby connection is made with the main reservoir A^1 . The brake-cylinder C is of the usual construction. An air-receiver, D, is attached to the bottom of the car A. This receiver should ordinarily be somewhat larger than the brake-cylinder C, and strong enough to sustain a pressure of, say, one hundred pounds per square inch, more or less. It may be used as a reservoir auxiliary to the main reservoir A^1 , or as an independent reservoir, one on each car, for storing up the air necessary to apply the brakes. In this latter use I combine with it any known device for compressing air, such as an air-pump, fan-blower, steam-injector, &c.; and if an air-pump it may be worked by an eccentric on one of the car axles A^2 or in other known way. A pipe or air passage then extends directly or indirectly from it to the brake-cylinder C, with a stop-cock device therein, by which the compressed air is admitted at pleasure from such reservoir D to the brake-cylinder, so as to apply the brakes in the usual way. By the means

set forth reservoir D is recharged from time to time, as may be necessary, in order to keep a store or supply of compressed air always on hand and ready for use. But the chief use which I contemplate for this reservoir D is as an auxiliary to the main reservoir A^1 . One brake-pipe, B, I use in the ordinary way for conveying compressed air from the main reservoir A^1 to the brake-cylinder C, and the other pipe, B^1 , I always keep in open communication with the main reservoir A^1 , so that it is always filled with compressed air; but it is immaterial in the construction shown which pipe is used for either purpose. A cross-pipe, $B^2\ B^3$, connects the pipes $B\ B^1$, and from their point of junction the pipes $b\ b^1$ branch off, one to the brake-cylinder C and the other to the auxiliary reservoir D. At the junction of these pipes in a suitable case, d , I arrange a cock, d^1 , having two non-communicating ports, $a\ a^1$, such that in one adjustment they will open communication from B^2 to b , and from B^3 to b^1 ; and in the other adjustment from B^3 to b and from B^2 to b^1 . With the adjustment shown the pipe B^1 is to be used as a reservoir pipe for containing compressed air and conveying the

ame to the auxiliary reservoir D, and the other pipe B is the ordinary operating pipe for operating the brakes in the usual way.

It will be seen that by turning the cock d^1 one quarter way around the relation of the pipes B B¹ to the auxiliary reservoir D and the brake-cylinder C will be reversed, but that the operation otherwise will remain the same. I also so construct my apparatus that when a car leaves the track or becomes uncoupled from the train the brakes will be automatically applied by means of the compressed air which is stored up in the reservoir-pipe and the auxiliary reservoir.

For this purpose I connect the pipes B B¹ with each other near the ends of the car by cross-pipes E E¹. In two diagonally-opposite corners of the parallelogram thus formed I make cases e^1 for the three-way cocks e , though one such cock and case will suffice to perform the function in view. When the cars are running these cocks are both in the position shown at the upper right corner of Fig. 1, so as to leave a free communication through the pipes B B¹. Each cock e is provided with a handle or arm, which (by means herein-after described) is, when a coupling breaks or a car leaves the track, shifted so as to throw the cock to the position shown at the lower left-hand corner of Fig. 1, by which through communication is closed and the compressed air passes from the reservoir-pipe B¹ and auxiliary reservoir D around through the operating-pipe B and pipes B² b to the brake-cylinder C, and applies the brakes.

To give the cocks e this throw I have shown two devices, which are illustrated in Figs. 1, 5, and 6. In Fig. 6, e^1 represents the cock-case; e^2 , the stem of the cock e ; and e^3 , the shifting-handle, which, in this figure, is in the position it occupies when through communication is open. From a wrist on this handle e^3 a crank-arm, m , extends back to, and, by a catch m^1 , engages, a counter-catch, o . A spring, m^2 , or its equivalent, a weight, is arranged in connection with the crank-arm m , so that when the catch is released the arm will, by a forward throw, shift the position of the cock e , as above indicated. To effect this release I introduce under the arm m a tripping-head or lever, i , preferably of circular form, so that it will bear against the arm m whichever way it is moved, and from at or about its central point a tripping-stem, i^1 , extends downward such distance that when the car is on the track, it will clear the ground, but when the car leaves the track, it will strike the ground, the track, or ties, and, by a vertical, forward, or back or side motion, lift the arm m and disengage the catch with the result already stated. But to shift the position of the cock when the car-couplings break, while the car is still on the track, I run a cord or chain, y , or equivalent device from the outer end of the handle e^3 forward and attach it to the hose-coupling y^1 of that or the next car at such point forward of the "slack" that when the car-couplings break and the slack-hose is straightened out the handle e^3 will by the cord y , be drawn over far enough to shift the position of the cock e , as already explained. In this way the brakes are automatically applied, in case of accident, to any part of the train. The same wire or chain y , or another, may extend in like manner from the coup-

ling y^1 to the stem i^1 , or to any other device which will disengage the catch $m^1 o$ with like result to that already stated. A slot, x , is made in the forward or outer end of the arm m , in which the wrist of the handle e^3 plays, in order that the cock may be shifted by the wire y independently of the arm m . But other devices for automatically shifting the cock e may be employed; my present invention not being limited to those described. To the main reservoir A^1 is attached any suitable form of pressure-gauge, as shown at f , and to each brake-pipe $B B^1$ I attach a pressure-gauge of like suitable form $g g^1$, and arrange in convenient proximity to each an alarm-whistle $h h^1$. These gauges $g g^1$ and whistles $h h^1$ are for use in signaling. Each one has a graduated index (illustrated in Fig. 4) so constructed, with reference to the pressure of air in the pipes, that a certain amount or degree of pressure—say one-half pound per square inch—shall send the index finger s to the graduation 2; a pressure a little greater, to 3; and so on. By a system agreed on, each graduation indicates a separate order or message, as “flag station,” “stop for orders,” “danger—run slow,” “danger—stop,” &c.; the highest or last graduation, preferably, indicating “stop.” The gauge is so constructed that greater degrees of air pressure will not affect it. In each car a like gauge is arranged, as shown at g^2 , Fig. 3, and a pipe connection, n, n^1 , extends from it to the brake-pipes $B B^1$. This gauge is arranged at any suitable point in the car, and its pipe connections are fitted with a cock, 1201-1203 n^2 , which is accessible to the conductor, and of which he carries the key. These pipe connections $n n^1$ and cock n^2 are such that, on the cock n^2 being opened, the compressed air will be admitted from the reservoir-pipe (say B^1) both to the gauge g^2 and to the other or operating-pipe B , along which it will pass to the gauge g in the engineer's cab. The conductor opens the cock n^2 till the pressure of air has moved the index finger s to the graduation which indicates the order he wishes to give the engineer, and then closes it. The index finger on the engineer's gauge will, in like manner, be carried to the same graduation, and the alarm of the whistle will call his attention to it. By reversing the operation the engineer may communicate messages to the conductor.

I do not deem it necessary to describe more minutely the ports and passages leading from the pipes $n n^1$ to the gauge g^2 , as a suitable arrangement of such devices, on the function being known, can be readily made by those skilled in the art. Where one of the brake-pipes is always used as a reservoir-pipe, and the other as an operating-pipe, only one of the gauges $g g^1$ will be required, and, of course, it should be arranged on the operating-pipe.

It will be seen that the conductor, by fully opening the cock, in case of extreme danger, will be enabled to apply the brakes himself, as well as notify the engineer, since the air will flow over by the pipes $n n^1$ from the reservoir-pipe B^1 to the operating-pipe B , and thence to the brake-cylinders. Also, that if it be desired to communicate but a single order, the gauges $g g^1 g^2$ may be dispensed with, and the order be communicated by a whistle blast.

What I claim as my invention, and desire to secure by letters patent, is—

1. An air-reservoir arranged on each separate car in combination with an air-brake cylinder, D, and main reservoir A¹ on or near the locomotive, substantially as and for the uses set forth.

2. The combination of the pipes B B¹ B² B³ b b¹ with a suitable arrangement of ports for admitting air to the auxiliary reservoir D and brake-cylinder C, substantially as and for the uses set forth.

3. The cock d¹ having ports a a¹, and arranged relatively to the air-reservoir D, brake-cylinder C, and pipes B B¹, substantially as described.

4. A cock, e, arranged in an air-brake pipe, with a suitable arrangement of ports inside and an automatically-operating connection outside, whereby, in case of accident, a free communication will be opened from an auxiliary reservoir, C, to a brake-cylinder, D, and external communication be closed, substantially as set forth.

5. In combination with a pair of air-brake pipes, B B¹, a signaling apparatus consisting essentially of an alarm or index gauge, or both, on or near the engineer's cab, a pipe connection on or in one or more of the cars, from one pipe, B, to the other, B¹, and like means in connection therewith for regulating or fixing the alarm to be given, substantially as set forth.

In testimony whereof I, the said George Westinghouse, Jr., have hereunto set my hand.

GEO. WESTINGHOUSE, Jr.

Witnesses:

JOHN H. JOHNSON.

G. H. CHRISTY.

1205

UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., of Pittsburg, Pennsylvania.

Improvement in Valve Devices for Fluid-brakes.

Specification forming part of Letters Patent No. 141,685, dated August 12, 1873; application filed May 24, 1873.

To all whom it may concern :

Be it known that I, George Westinghouse, Jr., of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful improvement in valve device for fluid-brakes; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawing, which represents in section my improved valve device, designed to be used in connection with a system of brake-pipes, brake-cylinder, and auxiliary reservoir, for the purpose of applying the brakes on railway trains by means of fluid-pressure.

In the system of steam-power air-brakes heretofore described in various patents, provision is made for the flow of air or other fluid under pressure from the brake pipe or pipes into a reservoir arranged under or in connection with each car, and for applying brakes by allowing the compressed air thus stored up in each reservoir to pass into the brake-cylinder. In such combination a triple valve has been described of such construction and with such connections that, by a continuous pressure of air in the brake-pipe, communication was kept open thence to each reservoir and closed to the brake-cylinder, but kept open from the latter to the external atmosphere; and, also, by lowering the pressure of air in the brake-pipe, communication was opened from each reservoir to the brake-cylinder of the car, and all other communication closed.

My present invention relates to an improved construction of triple valve, by means of which this operation is more advantageously effected, and has more particular reference to the construction of devices by which a flow of compressed air from each auxiliary reservoir to its brake-cylinder can be regulated at pleasure, and thereby the brakes be applied with any desired degree of force less than the maximum.

To enable others skilled in the art to make and use my improvement, I will proceed to describe the same.

(Here follows diagram marked p. 1204.)

The valve-case G is of the form substantially as shown, so as to give a valve-chamber, G¹, into which at or near one end a port, G², opens, and at or near its opposite end a like port, G³, also opens. The same valve-case includes also a valve-chamber, H, with a communicating passage, B, and the air-port H' communicates with the valve-chamber H. The valve-stem g has a limited range of motion

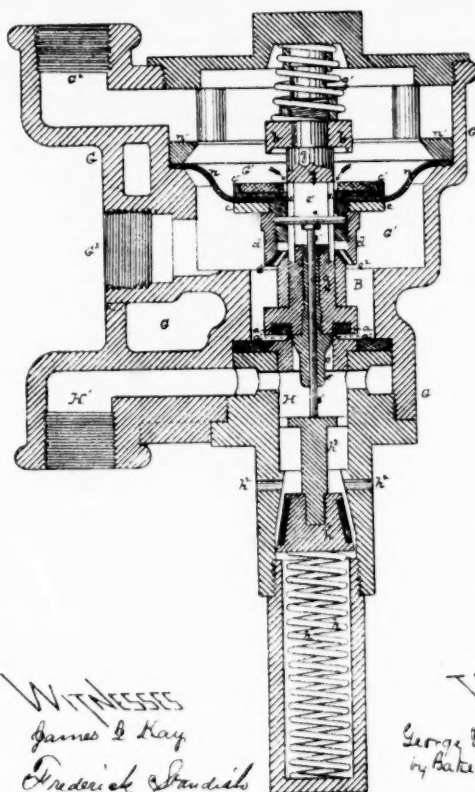
No. 403 & 426.
Westinghouse Co. } *S. 1204*
Dyducks.

G. WESTINGHOUSE, Jr.

Valve Devices for Fluid-Brakes.

No. 141,685.

Patented August 12, 1873.



WITNESSES
James B. Kay
Frederick Sandels

George Westinghouse Jr.
by Batewell, Christy & Co.,
his attys.



in the chamber G^1 . At or near its lower end it carries a valve, a , which seats on the annular V-shaped seat a' by suitable packing on its lower face. A spring, g' , bearing against the cap of the valve-case G , and against the upper face of the valve-seat b , holds the lower valve a to its seat, when not raised therefrom by air-pressure. The flexible diaphragm n divides the valve-chamber G^1 into two parts. The outer edge of this diaphragm or ring n is compressed between an annular metallic ring, n' , and a shoulder on the valve-case; and the inner edge of said ring around the stem g is compressed between the different parts of the compound nut $c c'$, which nut is free to move vertically on the stem g , and the upper face c' of which is provided with a suitable packing, so as to make a tight joint when brought against the annular ring of the valve-seat b . Commencing at a point a short distance below the upper valve seat b , the stem g is turned smaller or reduced in size, as at e , and is also slotted, as indicated at e^1 . This reduction in the size of the stem g gives an annular air-port, e , by which communication is secured from the upper to the lower part of the valve-chamber G^1 . The compound nut $c c'$, which constitutes mechanically a piston, has a downward extension around the stem g , as shown at d , by means of which, in moving up and down on the stem g , it covers and uncovers the port e , and thereby closes and opens communication between the upper and lower parts of the valve-chamber G^1 . The lower end of the annular port e communicates with the lower part of the valve-chamber G^1 by means of ports e^2 , which may be made in any desired number. Across the slot e^1 in the stem g a cross-bar, s , is arranged, with its ends fixed in position in the adjacent walls of the nut c . From this slotted part e^1 a pin, s' , extends down through and lengthwise of the stem g into the chamber H . The lower end of the chamber H is fitted with a spring, h , which bears against the conical valve h^1 , having a suitable packing on its conical face. Such valve is arranged in its chamber so as to open and close the escape-ports h^2 . This valve is attached to a stem, h^3 , which, by means of wings of the usual form, causes the valve h^1 to move vertically in its chamber in opening and closing the ports h^2 . The pin s' is of such length and position that with the downward movement of the piston $c c'$ the cross-bar s will be caused to bear against its upper end and force its lower end against the stem h^3 of the valve h^1 , and thereby throw it from its seat and uncover the ports h^2 . The conical plug o is attached to the lower end of the stem g in such position as to enter the port o' , which connects the chambers G^1 and H ; but this plug o is of such shape as to graduate the size of the opening of the port o' , accordingly as it is raised more or less by the upward movement of the stem g . The valve-case described is, by the port G^2 , connected with the brake-pipes, by the port G^3 with the auxiliary reservoir, and by the port H' with the brake-cylinder. If air or other gas or fluid under pressure be admitted by the port G^2 , it will cause the piston $c c'$, with its diaphragm n , to be depressed or to slide down on the stem g until it occupies about the position shown. The cross-bar s will then have opened the valve h^1 , and the valve a will be

closed by means of the spring g' , or by fluid-pressure; also, the annular port e will open. In such case the air or other fluid will pass, as indicated by the arrows, from the upper part of the chamber G^1 , along the ports e e^2 , into the lower part of the chamber G^1 , and out at the port G^3 to the auxiliary reservoir, whereby the auxiliary reservoir will be charged with compressed air of such density as it may be desired to store up for the purpose of operating the brakes. At the same time, by the means already described, the valve h^1 is unseated, and thus a direct communication is opened from the brake-cylinder, through the port H' , chamber H , and ports h^2 , with the external atmosphere. The brakes are then off. As soon as the pressure on the upper and lower sides of the diaphragm n and compound nut c c' is equal, or nearly so, the spring h in the lower part of the case, acting against the valve h^1 through the stem h^3 , pin s' , cross-bar s , will cause the piston c c' to slide upward on the stem g , and thereby cut off communication through the annular passage e , and will seat the valve h^1 so as to close the escape-ports h^2 . Then, if the pressure above the diaphragm n be reduced by allowing a portion of the air to escape from the brake-pipes, the pressure of the air or other gas, acting back through the port G^3 on the under side of the diaphragm n , will raise the piston c c' against the valve-seat b , compress the spring g' , and, by raising the stem g vertically upward, will lift the valve a from its seat a' and thereby open communication from the chamber G^1 , through the port o , chamber H , with the port H' . The compressed air or other gas or fluid will then be free to pass from the auxiliary reservoir, through the ports G^3 , o' , and H' , to the brake-cylinder, so as to charge the same and apply the brakes in the usual way. The area of the opening through the port o' is regulated by the distance which the plug o is caused to move vertically upward. Hence, if the pressure be reduced but slightly at G^2 , the plug o will be raised but a short distance, and a small amount of compressed air or other fluid will be allowed to pass through and out at the port H' . When the equilibrium is thereby restored in the chamber G^1 , the valve a will resume its seat and close the communication. If the pressure in the upper part of the chamber G^1 be materially increased, the lower valve h^1 will be unseated, as already described, and an open communication be made from the brake-cylinder, through the port H' and h^2 , to the external atmosphere. By the use of the taper plug o , in the manner described, and by regulating, as can easily be done by the use of suitable cocks, the amount of pressure in the upper and lower parts of the chamber G^1 , it is easy to regulate the amount or density of the air which is permitted to flow through the port o' into the brake-cylinder, and consequently easy to regulate and adjust, at all times, the force with which the brakes are applied, and such force may be varied from the maximum power of the brakes down to the fractional part of a pound, in excess of ordinary atmospheric pressure.

The construction of the piston may be varied somewhat, provided its operation and function remain substantially unchanged.

What I claim as my invention, and desire to secure by letters patent, is—

1. The piston *c c'*, having separate and independently-operating connections to, and in combination with, a charging-valve, *a*, and discharging-valve *h'*, whereby the discharging-valve shall be closed at or before the opening of the charging-valve, substantially as set forth.

2. The pin *s'*, cross-bar *s*, and stem *g*, in combination with the piston *c c'*, valves *a* and *h'*, and plug *o*, arranged substantially as set forth.

In testimony whereof I, the said George Westinghouse, Jr., have hereunto set my hand.

GEORGE WESTINGHOUSE, JR.

Witnesses:

T. B. KERR.

G. H. CHRISTY.

1211 UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., of Pittsburg, Pennsylvania.

Improvement in Steam and Air Brakes.

Specification forming part of Letters Patent No. 144,006, dated October 28, 1873; application filed July 24, 1873.

To all whom it may concern:

Be it known that I, George Westinghouse, Jr., of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful improvement in steam and air brakes; and I do hereby declare the following to be a full, clear, and exact description thereof, which, taken in connection with the accompanying sheets of drawings hereinafter referred to, forms a full and exact specification of the same, wherein I have set forth the nature and principles of my said improvement, by which my invention may be distinguished from others of a similar class, together with such parts as I claim and desire to secure by letters patent—that is to say:

In the specifications of patents obtained by me March 5, 1872, Nos. 122,404 and 122,405, and August 8, 1871, No. 117,841, were described various arrangements and constructions of pipes, valves, and apparatus, whereby compressed air could be made to operate brakes and communicate signals in a railway-train.

My present invention relates to an improved construction of the valves and pipe couplings employed in such apparatus.

(Here follow diagrams marked pp. 1208 & 1210.)

I will first describe my improved construction of valves, referring to figure 1, which represents a section of the valve-box. This valve-box has three chambers or compartments, and is provided with three valves, A, B, and C, united by one stem. The first or upper chamber communicates, by the end passage E, with the pipe by which compressed air is conveyed throughout the train, and, by the side passage F, with the auxiliary reservoir of compressed air. In this chamber there are two valves, A and B, on the same stem of which the upper valve, A, has a greater area than the lower valve, B, and has holes through it near its periphery covered by a disk, *a*, pressed against its back by a spring. The second chamber communicates, by a side passage, G, with the brake-cylinder, and the third chamber has an opening, H, to the atmosphere. This third chamber contains the third valve, C, also on the same stem, which can close upward against a caoutchouc or leather seating, *c*, when the valve A is closed against its upper seat. The seating *c* is made with a little space between its inner edge and the body of the valve-box, so that when the valve C bears against it the pressure of

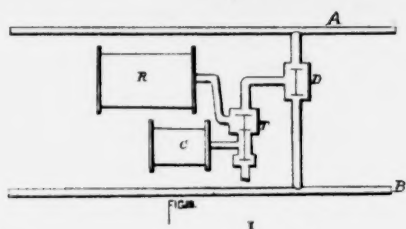
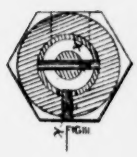
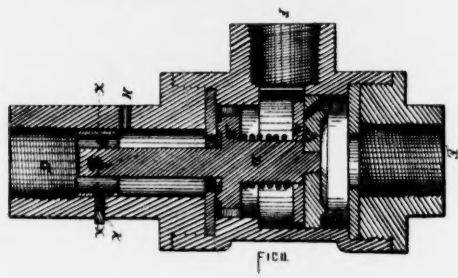
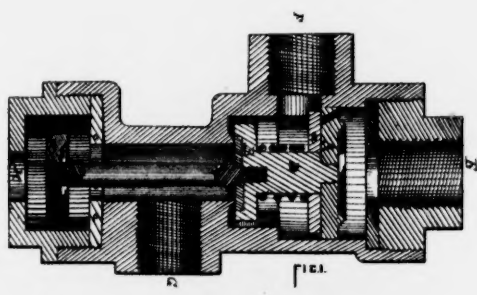
*Nos. 403,1426
Westinghouse Co } p. 1208
Bryden Co.*

2 Sheets--Sheet 1.

**G. WESTINGHOUSE, Jr.
Steam and Air-Brakes.**

No. 144,006.

Patented Oct. 3, 1873.



WITNESSES.

*R. W. Westinghouse
J. Isaac Kay*

INVENTOR

*George Westinghouse Jr.
by B. A. Russell, Christy & Co.
his attys*



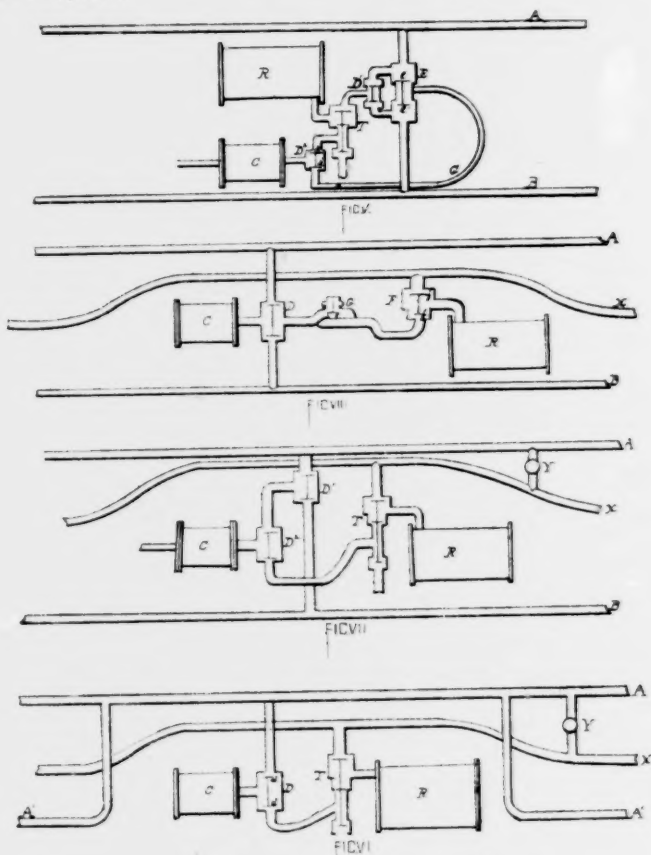
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 Royden Co.

2 Sheets--Sheet 2.

G. WESTINGHOUSE, Jr.
 Steam and Air-Brakes.

No. 144,006.

Patented Oct. 28, 1873.



WITNESSES.

Robertson
 James D. May

Inventor.

George Westinghouse
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the seating shall press it against the raised annular edge of valve C, and thereby insure the tightness of its closure.

The operation of these valves is as follows: Assuming that the primary reservoir is not charged with compressed air, when compressed air is admitted into the air-pipe it enters by the passage E, its pressure acting on the larger valve A, opens it and closes valve B. The compressed air thus admitted flows through the opening in the valve A, pressing away the disk *a* that covers them, by the passage F, to the auxiliary reservoir, which it charges. At the same time the valve C, being on the same stem with A and B, is opened, and air from the brake-cylinder issues, by the passage G, at the valve C and through the opening H to the atmosphere; and the brakes are taken off by relieving the piston in the brake-cylinder from pressure.

Now if it be required to put on the brakes, air is allowed to escape from the air-pipe, either by opening a cock or valve by hand or automatically, (in the manner described in the specifications referred to above,) when the air-pipe or its connections give way, or a carriage becomes detached or runs off the line. The auxiliary reservoir having been charged with compressed air, as described above, the pressure communicated through the passage F from the larger area of the valve A, and finding no escape by the holes in its periphery, which are closed by the disk *a*, raises the valve against its seat, and so closes communication with the air-pipe by the passage E. At the same time the valve B is opened, the valve C is closed. Compressed air then flows from the primary reservoir by the passage F, past the valve B, through the passage G to the brake-cylinder, where it acts on the piston so as to put on the brakes.

Thus, by means of this triple-valve arrangement, when the air-pipes communicating with E are charged with compressed air the primary reservoirs are charged and the brakes are taken off, and when air is discharged from the air-pipes, the brakes are put on by the action of the air stored in the auxiliary reservoir.

Fig. 2 represents a section of a construction of such a valve-box in which the lower disk-valve C is replaced by a sliding-ring valve, K. In this case the opening to the atmosphere is a side passage, H, and the communication to the brake-cylinder is at the end passage G.

Fig. 3 represents a sectional plan on the line X X. The ring K is a circular slide, which closes the opening H when the valve is retracted, and leaves it open, as shown in Fig. 2, when the valve is extended.

The ring is divided at one side to allow it to spring so as to make a tight fit in the cylindrical part of the valve-box in which it is seated, and a steady-pin, *k*, projecting into the slit of division prevents the ring from turning round. The ring is connected to the valve-stem by a pin, *l*, passing through the sides of the ring and the stem. The action is in this case the same as that described with reference to Fig. 1.

We have described the action of this valve arrangement as if it

communicated with only one air-pipe. By combining it, however, with double valves connected by a stem, such as have been described in the specifications above referred to, either or both of the duplicate air-pipes serve to work upon the auxiliary reservoir and brake-cylinder, as above described.

By referring to the before-mentioned specifications it will be seen that these double valves are of two kinds, one which opens the passage from the pipe of higher pressure and closes the passage to the pipe of lower pressure, and the other which closes the passage from the pipe of higher pressure and opens that to the pipe of lower pressure.

In connecting the duplicate air-pipe with the valve-box above described, and with the brake-cylinder, such double valves may be arranged in the manner shown in the diagram plan, Fig. 4. In this diagram A and B represent the two air-pipes, communicating throughout a train; R, the auxiliary reservoir; and C the brake-cylinder. T is the triple-valve arrangement, above described, and D is one of the double-valve arrangements described in the specification above referred to, whereby either of the pipes A or B, that contains air at lower pressure than the other, is cut off. It will be seen that compressed air conveyed along either or both of the pipes A and B will operate on the auxiliary reservoir R and the brake-cylinder C by means of the triple-valve arrangement T, in the manner above described.

Sometimes it is desirable that either of the two communicating air-pipes may be employed to charge the reservoir, while the other pipe may be used to operate the brakes. An arrangement of valves for this purpose is shown in the diagrammatic plan, Fig. 5, where A and B represent the two air-pipes; C, the brake-cylinder; R, the auxiliary reservoir; T, the triple-valve arrangement, above described; D¹ and D², double valves, such as that marked D in Fig. 4; and E, one of the other kind of double-valve arrangements, described in the former specification referred to above, whereby the pipe containing air at higher pressure is cut off from communication.

From this arrangement it will be seen that one of the pipes—such as A—may be employed to charge the reservoir R, the compressed air from A passing by the one end of E, and past one of the valves in D¹, acting on the large valve in T, so as to open it and the farthest valve, and close the middle valve of T, and passing the larger valve of T to the reservoir R. At the same time the other pipe, B, may be charged with compressed air for putting on the brakes, the air from that pipe passing the open valve *e'*, and thence by the pipe G to the valve-box D², where it will open the valve *d'* and close *d*, and thence to the brake-cylinders C, where the pressure will act on the piston so as to put on the brakes. If, now, the pipe B be relieved of pressure, then, the valve *e* being closed and *e'* being open, the air in the pipe G will have its pressure reduced. The valves *d* *d'* will then be in equilibrium, allowing the air from the brake-cylinder to escape past either or both of them, and either past the third valve in T to the atmosphere, or by the pipe G and past

the valve e' to the discharge-pipe B. Again, assuming the reservoir R to have been charged with compressed air, and the pipe B to be relieved of pressure, by relieving the other pipe A of pressure the brakes will be put on, for the valves in E and D¹ being then in equilibrium the pressure is taken off the large valve in T, which is therefore closed, opening the second valve in T and closing the third, so that compressed air will flow from R past the open valve in T, and opening the valve d and closing d' into the brake-cylinder C.

Two pipes communicating throughout a train may be applied in connection with valves in the manner represented on the diagram plan, Fig. 6. Here the one air-pipe A is shown with branches A' at each end of the carriage for convenience of coupling, as has already been described by me in the former specifications referred to. The other pipe, X, communicates with the triple-valve arrangement T. Assuming that X is charged with compressed air, it charges the auxiliary reservoir R, keeping open the large valve in T and the third valve, and closing the middle valve. Then compressed air admitted into the pipe A will open the valve d and close d' , and pass into the brake-cylinder C, so as to put on the brakes; and when air is discharged from A, the valves d and d' being in equilibrium, the air from C will pass either d into the pipe A or d' past the third valve in T to the atmosphere, and thus the brakes will be taken off. Again, the pipe A being relieved of pressure the brakes can be put on by discharging air from the pipe X, for then the larger valve in T and the third valve will be closed, and the middle valve will be opened, so that compressed air will flow from the reservoir R past the valve d' to the brake-cylinder C. The air can be discharged from X, either by a cock or valve opening, directly to the atmosphere, or by a cock, Y, in a branch connecting X with A.

In this case the air admitted from X to A may serve for signaling by sounding-whistles or working-gages connected to the pipe A in the manner described in former specifications referred to. Instead of one pipe, A, with branches A', as shown in Fig. 6, two pipes A and B, with a third pipe, X, may be employed, as shown in the diagram plan, Fig. 7. Here it will be seen that either of the pipes A or B can be employed to work the brakes, while X, when charged, is employed to charge the reservoir R, and when discharged to permit the air stored in the reservoir to work the brakes. The contents of the pipe X may be discharged into the atmosphere by a cock or valve, or into one of the other pipes, as A, by means of a branch provided with a cock or valve, the pipe A being thus rendered available for communicating signals. The three pipes A, B, and X may be employed with a combination of valves such as is shown in the diagram plan, Fig. 8, where F represents a double-valve arrangement, such as was described in previous specifications referred to, having the upper valve f of larger area than the lower valve f' . D is a double-valve arrangement like that described above and marked with the same letter, and G is a check-valve of any known description. It will be seen that the reservoir R can be charged from the pipe X, the valve f being opened and f' closed by the pressure of the air in the pipe X. At the same time

the brakes can be put on by charging either or both of the pipes A or B with compressed air, and taken off by discharging the air from both. Again, if the pipes A and B be closed, and air be discharged from X, the air stored in the reservoir R closes the valve *f*, opens *f'* and passes G to the brake-cylinder C, so as to put on the brakes, and also to charge the pipes A and B for communicating signals. In this case the check-valve G performs the function of the third valve C above described, and in such construction is the mechanical equivalent therefor, the valves *f f'* corresponding in function and structure to the two upper valves of Fig. 1.

It will readily be understood that the several kinds of valve arrangements described in this and in the former specifications referred to can be combined in many other ways, so as to effect the working of brakes and communication of signals according to various systems of operation.

The arrangements shown in the diagrams, Figs. 4, 5, 6, 7 and 8, described above, are given as examples of how such combination of valves may be made, and although in these, for the sake of distinctness, the several valves are shown as if they were fitted in separate chambers, it may be readily understood that they might be fitted into separate compartments of one valve-box, so as to secure greater simplicity and compactness of construction. The same features of construction and combination may be employed in connection with hydraulic gas or other fluid brakes. In connection with hydraulic brakes, an accumulator should take the place of the reservoir.

What I claim as my invention, and desire to secure by letters patent, is—

1. The combination of the triple valve A B C, seated as described, the valve-case connection E, above the valve A, to an air-supply pipe, a connection, F, between the valves A B with an auxiliary reservoir, a connection, G, below the valve B, with the brake-cylinder, substantially as set forth.

2. A triple valve arranged, in combination with a line of brake-pipe, auxiliary reservoir, and brake-cylinder, so that by the introduction of compressed air or steam the auxiliary reservoir will be charged and the brakes let off, and when the air is let off from such pipes an opening will be made from the auxiliary reservoir to the brake-cylinder, substantially as set forth.

In testimony whereof I, the said George Westinghouse, Jr., have hereunto set my hand.

GEORGE WESTINGHOUSE, JR.

Witnesses:

JOHN H. BAILEY.

G. H. CHRISTY.

W. D. JONES.
Air-Brakes.

2 Sheets--Sheet 1.

No. 166;386.

Patented Aug. 3, 1875.

Fig. 1.

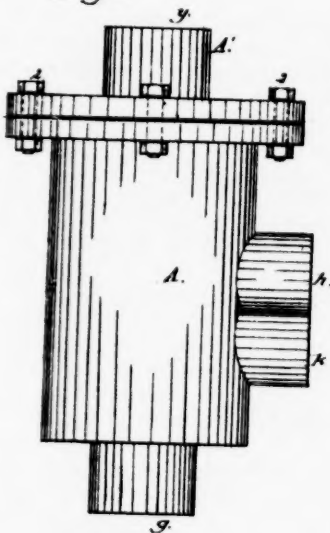


Fig. 3.

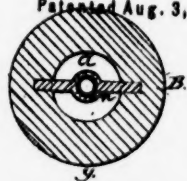


Fig. 2.

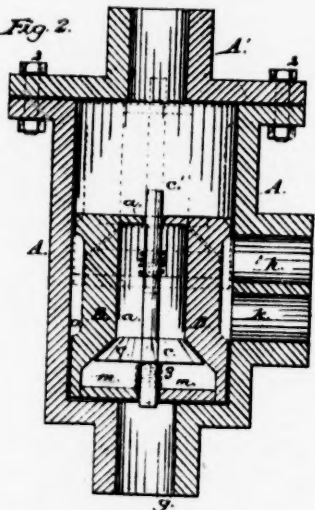
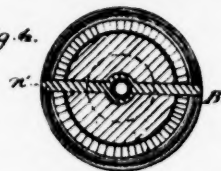


Fig. 4.



No. 4034426.
Wettershouse Co. } p. 1216.
Oryden Co.

Witnesses:

Oppele & Perkins
Henry E. Green

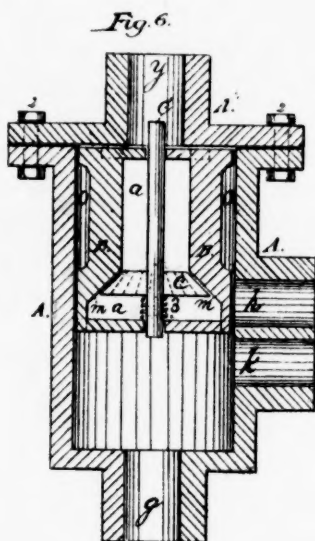
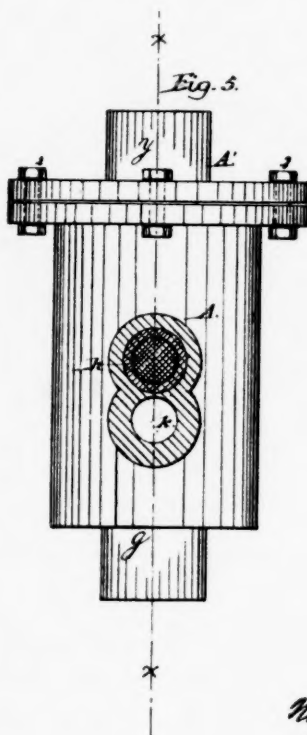
Inventor:

W. Davidson Jones

W. D. JONES.
Air-Brakes.

No. 166,386.

Patented Aug. 3, 1875.



No 4030426.
Attestation } p. 1218
Hydraulic

Witnesses:
G. W. R. R. R.
Henry E. Evans

Inventor:
W. Davidson Jones

1219

UNITED STATES PATENT OFFICE.

W. DAVIDSON JONES, of Hagaman's Mills, New York.

Improvement in Air-brakes.

Specification forming part of Letters Patent No. 166,386, dated August 3, 1875; application filed July 27, 1875.

To all whom it may concern :

Be it known that I, W. Davidson Jones, of Hagaman's Mills, in the county of Montgomery and State of New York, have invented a new and useful improvement in automatic-supply relief-valves for operating compressed air-brake cylinders; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, making part of this specification, in which—

(Here follow diagrams marked pp. 1216 & 1218.)

Figure 1 is a side elevation of the valve. Figs. 2 and 6 are sectional views of Fig. 1, on the plane of the line xx in Fig. 5, showing the induction and eduction ports, the compound trunk-valve B B, and valve c on the stem c' , held to its seat $m m$ by springs 3 3. Fig. 3 is a transverse section of the end of trunk-valve B B, showing the passage a and valve-stem guide n . Fig. 4 is a transverse sectional view of the opposite end of the compound trunk-valve B B, showing the valve c and valve-stem guide n' . Fig. 5 is an elevation of the valve, looking at the ports h and k .

Like letters and figures of reference indicate like parts in each drawing or figure.

My invention relates to that class of compressed air-actuated car-brakes in which the air is conveyed back to reservoirs beneath each car by a pipe from a main reservoir on the engine, the compressed air from the auxiliary reservoirs on each car of the train operating a movable piston within a cylinder, thereby applying the brake-blocks to the wheels, as is commonly done. By the interposing of my invention in close connection therewith, and between or by its use forming the connections between the auxiliary reservoir, the cylinder containing the piston, and the branch-pipe from the main supply-pipe, the brakes may be rapidly and readily applied, and as rapidly and readily released, at the will of the engineer, or automatically set on all the cars of the train, should the cars become uncoupled, or the main supply or branch pipes become broken, as will be hereinafter fully set forth.

My improved automatic-supply relief-valve for connecting the branch induction-pipe with the auxiliary reservoir, and at the same time closing connections with the brake-cylinder, and at the will of the engineer (or in case of accident uncoupling of cars, or rupture of main pipe from the reservoir on the engine or tender) to close

such connections, and to automatically open connections between the auxiliary reservoir and the brake-cylinder, thereby allowing the compressed air to pass to said cylinder, actuating the piston thereof and applying the brakes, as is usually done, and as readily relieving the cylinder of the compressed air, and discharging it by opening communication from the cylinder with the atmosphere, and at the same time restoring the connection between the main supply-pipe and auxiliary reservoir by decreasing and increasing the pressure in the main supply-pipe running the whole length of the train.

My invention may be used to operate the pistons of brake-cylinders attached to each car where there is no auxiliary reservoir employed, and discharge the compressed air directly from the cylinder, after doing its work, into the atmosphere, without returning it to the engine through the supply-pipe, the same being done by simply cutting off the supply or pressure from the main supply-pipe.

To enable others skilled in the art to make and use my invention, I will proceed to describe its construction and operation.

A is a valve-case, made substantially as shown, and provided with a cap, A', containing the induction port or passage *y*, said port connecting with the main supply-pipe from the engine, and being also provided with eduction pipe or port *g*, to which is connected the auxiliary reservoir and eduction-induction port *k* communicating with the brake-cylinder, and eduction-port *h* communicating with the atmosphere. The cap A' is secured to the shell-case A by bolts 2.

The compound trunk-valve B, Figs. 2 and 6, is made of proper form, substantially as shown, having the circumferential depression *o*, Figs. 2 and 6, and valve-seat *m*, valve *c* on valve-stem *c'*, is held in position by valve-stem guides *n n*, Figs. 3 and 4. Said valve *c* is held to its seat *m*, Figs. 2 and 6, by spiral spring 3.

The operation of my invention is as follows: With the 1220 port *y*, Figs. 1, 2, 5, and 6, connection is made with the supply-pipe leading from the main reservoir on the engine. With the port *g* connection is made with the auxiliary reservoir. With the port *k* connection is made with the brake-cylinder, operating a piston within, and port *h* communicating with the atmosphere.

Compressed air being admitted from the main reservoir attached to the engine, through a three-way cock, into the supply-pipe and its branches to each car of a train, the compound trunk-valve B would be driven by the compressed air to the rear or lower end of the case A, and closing port *k* leading to the brake-cylinder, as shown in Fig. 2, the strength of the spiral spring 3 holding valve *c* to its seat *m* sufficiently firm to carry the compound trunk-valve B to the lower end, as shown in Fig. 2; the pressure would then unseat valve *c* on stem *c'* and allow the air to pass, through port *y*, passage *a*, and port *g*, into the auxiliary reservoir. The pressure in the auxiliary reservoir would be about equal to the pressure in the main reservoir and supply-pipes. The brake-cylinder would communicate with the atmosphere through port *k*, circumferential de-

ression *o*, and induction-port *h*, thereby leaving the piston free to return to the back of the cylinder by the action of the throw of springs attached to the brake-blocks, or through any other suitable agency.

When the engineer wishes to put on the brakes he turns the three-way cock near to him in the supply-pipe, cutting off communication with the main reservoir and opening communication with the atmosphere in that portion of the supply-pipe in rear or back of the three-way cock, thereby reducing the pressure in that portion of the supply-pipe and its branches leading to each automatic-supply relief-valve, which, by the excess of pressure retained in the auxiliary reservoir, would force a current of compressed air backward, closing firmly on its seat the valve *c*, Figs. 2 and 6, and driving the compound trunk-valve B into the forward part of valve-case A, as indicated by the dotted or broken lines in Fig. 2, and fully shown in Fig. 6, thereby opening full and free communication from the auxiliary reservoir, through ports *g* and *k*, into the brake-cylinder, thereby moving the piston, and, by suitable connections from said piston to the brake-blocks, applying the brakes.

When the train is stopped and the engineer wishes to take off or release the brakes, he turns the three-way cock so as to close communication with the atmosphere and open communication from the main reservoir on the engine with the supply-pipe, and to each automatic-supply relief-valve, which, by the excess of pressure in the main reservoir and supply-pipe over the reduced pressure of the expanded air in the auxiliary reservoir and brake-cylinder, causes a current of air to pass into the port *y*, Figs. 2 and 6, and, by the spring 3, holding valve *c* on its seat *m*, the compound trunk-valve B, Figs. 2 and 6, is driven from the position just described and fully shown in Fig. 6 to the position shown in Fig. 2, at the bottom or back end of the valve-case A, and simultaneously closing port *k* from communication with port *g*, Fig. 2, the compressed air from the supply-pipe unseats valve *c* and passing into the auxiliary reservoir until the equilibrium is restored, and, with the return of the compound trunk-valve B to the position shown in Fig. 2, communication is opened from the brake-cylinder, through port *k*, circumferential depression *o* on the compound trunk-valve B, and port *h*, Fig. 2, with the atmosphere, thereby allowing the air in the brake-cylinder to instantly escape, releasing at once, through the medium of the piston and connections, the brake-blocks.

It is evident that my invention can be used as a simple relief-valve, without any auxiliary reservoirs, by placing it between the brake-cylinder under each car and the branch-pipe leading from the supply-pipe, and making the following connections, that is, connecting the branch-pipe to the induction-port *y*, Figs. 2 and 6, and the brake-cylinder to port *g*, plugging port *h*, as shown in Fig. 5, by cross shading, to prevent dust and like matter from entering, as that port is not used.

The operation as a simple relief-valve is as follows: When the engineer wishes to put on brakes he turns the three-way cock in the supply-pipe, thereby closing communication with the atmosphere

and opening communication from the reservoir to each car through the supply-pipe and branch to port *y*, Figs. 2 and 6, forcing the trunk-valve B to the back end of the case A, thereby closing education-port *k*, as shown in Fig. 2, when the compressed air will unseat valve *c* and pass from the branch-pipe through port *y*, air-passages *a*, and port *g*, into the brake-cylinder, actuating the piston and putting on the brakes.

To release the brakes the engineer turns the three-way cock so as to close communication with the reservoir and open communication with the supply-pipe running back through the train with the atmosphere. As soon as the pressure in the supply-pipe is reduced the back-flow from the brake-cylinder commences, driving the compound trunk-valve B into the forward part of case A, as shown in Fig. 6, and opening communication from the brake-cylinder, through ports *g* and *k*, into the open air, thereby releasing the brake-cylinder piston and, through its connection, the brake-blocks.

The compound trunk-valve B may be packed at each end to prevent the leaking and injury, if so desired, and the valve-seat *m* may also be packed with suitable packing.

This supply relief-valve is automatic in its operation, is durable, and is free from liability to get out of order.

A stop-cock may be placed in the pipes leading from the auxiliary reservoirs to the valve-ports *g* on each car, so as to close the same in case a car is to be removed from the train to prevent the brakes from being set.

The port *h* may be placed on any side of the case A A', retaining its position lengthwise, without changing the nature of my invention.

The manner of its use and operation will be readily understood by those skilled in the art.

I am aware that it is not new in air-brakes to use a hollow piston-valve having a supplemental valve working therein, the latter opening against the pressure, and hence I make no claim to the same; but

What I claim, and desire to secure by letters patent, is—

The combination, with the valve-casing having ports *y*, *g*, *h*, and *k*, of the hollow piston-valve and check-valve inclosed therein, to open with the pressure, the ends of the piston-valve having perforated cross-bars to support the stem of the check-valve, substantially as and for the purposes specified.

W. DAVIDSON JONES.

Witnesses:

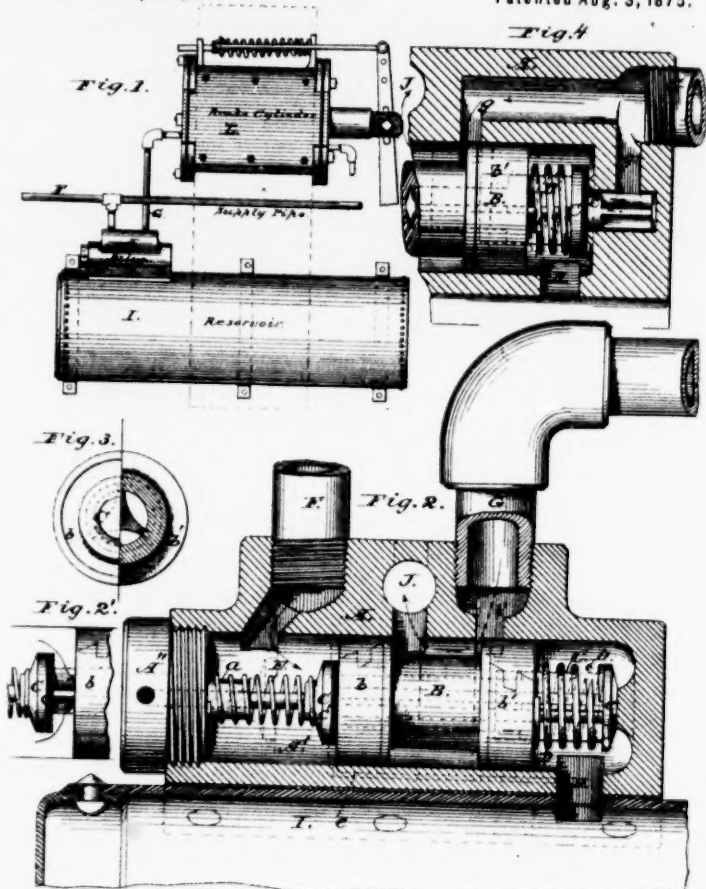
WM. M. PAWLINGS.
HENRY E. GREENE.

No 403 1426 }
 Westinghouse } 61224
 Dryden Co

H. L. PERRINE.
 Air-Brake.

No. 166,405.

Patented Aug. 3, 1875.



Attest:
 M. M. Haughw
 Wm. C. White.

Inventor.
 H. L. Perrine.

1225

UNITED STATES PATENT OFFICE.

H. LANSING PERRINE, of Freehold, New Jersey.

Improvement in Air-brakes.

Specification forming part of Letters Patent No. 166,405, dated August 3, 1875; application filed July 29, 1875.

To all whom it may concern :

Be it known that I, H. Lansing Perrine, of Freehold, in the county of Monmouth and State of New Jersey, have invented certain new and useful improvements in air-brakes, of which the following is a full, clear, and exact specification :

This invention is in the nature of an improvement in single-acting air-brakes, wherein each car is provided with an air-reservoir and a brake-cylinder, admission of air to both of which is controlled by an intermediately-located valve of peculiar construction, in such manner that, as air is being supplied through the pipes from the main reservoir at the locomotive, communication is open to the reservoir under each car, and cut off from the brake-cylinder, until the pressure in said reservoir equals that in the supply-pipes, when, if the pressure of air in the pipes is slackened or diminished, the valve opens the brake-cylinder inlet, and allows the air in the reservoir to escape into such cylinder and force on the brakes; and the invention consists in a tubular spring piston-valve operating in a chamber or shell having an inlet for the air, a reservoir-opening, and a combined supply and exhaust for the brake-cylinder, as hereinafter fully described.

Referring to the drawings,

(Here follows diagram marked p. 1224.)

Figure 1 is a top or plan view of an air-brake mechanism with my valve attached. Fig. 2 is a partly sectional view of the valve about full size. Fig. 2' is a side elevation of the front end of the valve open, or in position to allow air to flow into the reservoir. Fig. 3 is an end view of the valve in half-section and half-elevation. Fig. 4 is a sectional view of one end of the valve modified.

L represents a brake-cylinder, and I a reservoir, such as are usually attached to each car. A is a valve secured to or otherwise connected with said reservoir, and with the supply-pipe F, extending from the main reservoir on the locomotive, and further communicating with the brake-cylinder by a pipe, G. Within the casing or shell of valve A I make a chamber, A', and close its open end by a plug or nut, A''. In this chamber I make openings to receive the supply-pipe F and pipe G, leading to the brake-cylinder; also, an opening, H, leading into the reservoir. B is a valve having a

hollow center, in which a supplemental spring-valve, C, is placed, on which the valve B moves back and forth. The valve B is made in the form of a piston, with two heads, *b b'*, fitted with a peripheral steel or other packing, and connected by a stem of less diameter, and with a central cavity, in which fits the winged valve C. The valve C, near its rear end, is formed with a stop or shoulder, against which the valve B strikes in its backward movement, and is prevented from being forced back too far, whereby it might cover or close the reservoir-port H. This valve C has a packed flange or head, *c'*, for controlling the front of the opening in valve B, and said head is extended into a stem fitting into and guided by a socket, *a*, in the nut A'', and between said head *c'* and nut is arranged on the stem a coiled or other spring, E. The other end of the valve C is made with a head, *c*, between which and the piston B is arranged a coiled or other spring, D. In filling the reservoir air is turned into the supply-pipe, which, entering the valve, presses back the piston B, so as to force it away from the head *c'*, and allow the air to pass through the hollow valve B into the reservoir through opening H. The brake-cylinder port is then, between the heads *b b'*, cut off from communication with the reservoir and supply-pipe, and any air in said cylinder flows back through said pipe, and exhausts at port J. Now, when the pressure of air in the pipe F and reservoir is equalized, the supply may be withheld or withdrawn from said pipes, when the force of spring D, exerted against the valve B, will drive it up against head *c'*, and close said valve. This will carry head *b'* the other side of the brake-cylinder port, and establish communication between the reservoir and said brake-cylinder, and set the brakes. The spring E serves simply to insure an easy and accurate working of the valves B C.

It will be seen that the valves B C combine to make a double-acting valve with relation to the reservoir and cylinder.

When the brakes are to be let off, the air is turned into the pipes F, and the first-described operation repeated, springs or other means being employed to retract the brakes.

1226 The modification illustrated in Fig. 4 shows ports *g g'*, for supplying air to the cylinder. Port *g* is controlled by head *b'*, and port *g'* by a winged plunger, P, working in a recess at right angles to said port, and operated by its connection with valve C. This insures a quick supply to the cylinder, and the spring E can be dispensed with.

Provision for any necessary movement of valve C is made by extending the socket *a*. It may be necessary to make an opening or way, *e*, leading from the reservoir to the front of the valve-casing, in order to insure the equalization of pressure on the piston-valve that may be lacking by reason of leakage in the pipes or elsewhere.

I am aware that it is not new in air-brakes to use a hollow piston-valve having an inclosed check-valve opening with the pressure, and, therefore, I make no claim to the same; but,

Having thus described my invention, what I claim is—

The combination, with the valve-casing, having ports arranged substantially as described, of the hollow piston-valve and a supplemental wing-valve, the latter, when serving to admit air to the reservoir, opening against the pressure, as and for the purpose set forth.

To the above specification of my invention I have signed my name this 29th day of July, A. D. 1875.

H. LANSING PERRINE.

Witnesses:

WM. H. FINCKEL.

A. C. BRADLEY.

GEORGE WESTINGHOUSE, JR., of Pittsburg, Pennsylvania.

Improvement in Air-valves for Power-brakes.

Specification forming part of Letters Patent No. 168,359, dated October 5, 1875; application filed August 19, 1875.

To all whom it may concern :

Be it known that I, George Westinghouse, Jr., of Pittsburg, county of Allegheny, State of Pennsylvania, have invented or discovered a new and useful improvement in air-valves for power-brakes; and I do hereby declare the following to be a full, clear, concise, and exact description thereof, reference being had to the accompanying drawing making a part of this specification, in which—like letters indicating like parts—

(Here follow diagrams marked pp. 1228 & 1230.)

Figure 1, sheet 1, is a longitudinal and vertical sectional view of a valve-case, valves, connections, and ports, illustrative of my improvement. Fig. 2, sheet 2, is a transverse section thereof through $x x$, Fig. 1. Fig. 3, sheet 1, is a detached sectional view of the cock and connecting-ports; and Fig. 4, sheet 2, illustrates in outline the arrangement of my improved valve device in a system of air-brake apparatus.

My present improvement is particularly designed for use as a part of a system of brake apparatus now generally known as the Westinghouse automatic brake, and consists of certain improvements in the devices by the agency of which the flow of the compressed air, both as to direction and amount to and from the auxiliary air-reservoirs and brake-cylinders, is effected and regulated; and it further consists in the incorporation of suitable devices, by means of which the parts peculiar to the automatic system of operation are thrown out of operation or cut off, so that the brakes shall be set or put on by the direct admission of air from the brake-pipe to the brake-cylinder.

The valve-case D is made of cylindrical form, for the most part, though of different diameters at different points, as shown. It incloses a piston-chamber, a , a valve-chamber, a^1 , and a communicating passage, a^2 . A screw-cap, D^1 , closes its larger end. In the periphery of this cap I cut an annular air-groove, c , from which a series of radial air-ports, c' , in any desired number, open into an annular space, a^3 , which latter opens directly into the piston-chamber a . This cap has a tubular extension, d , into the outer end of which I screw a stem-guide or bush, d^1 . The upper end of the bush affords a bearing for one end of a spiral spring, d^2 , which latter, at its opposite end, bears against a collar, d^3 , on the stem d^4 , so as to hold the stem up when not depressed, as hereinafter described.

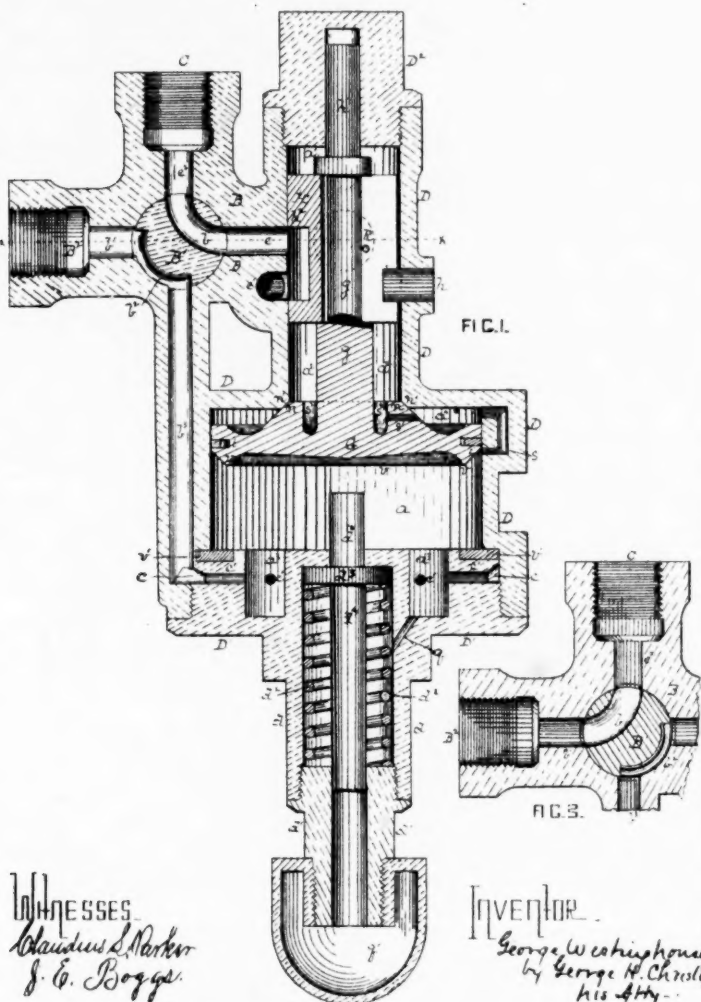
No. 413 1426 }
 Westinghouse & Co. } p 1228
 Dryden Co.

2 Sheets--Sheet 1.

G. WESTINGHOUSE, Jr.
 Air-Valve for Power Brakes.

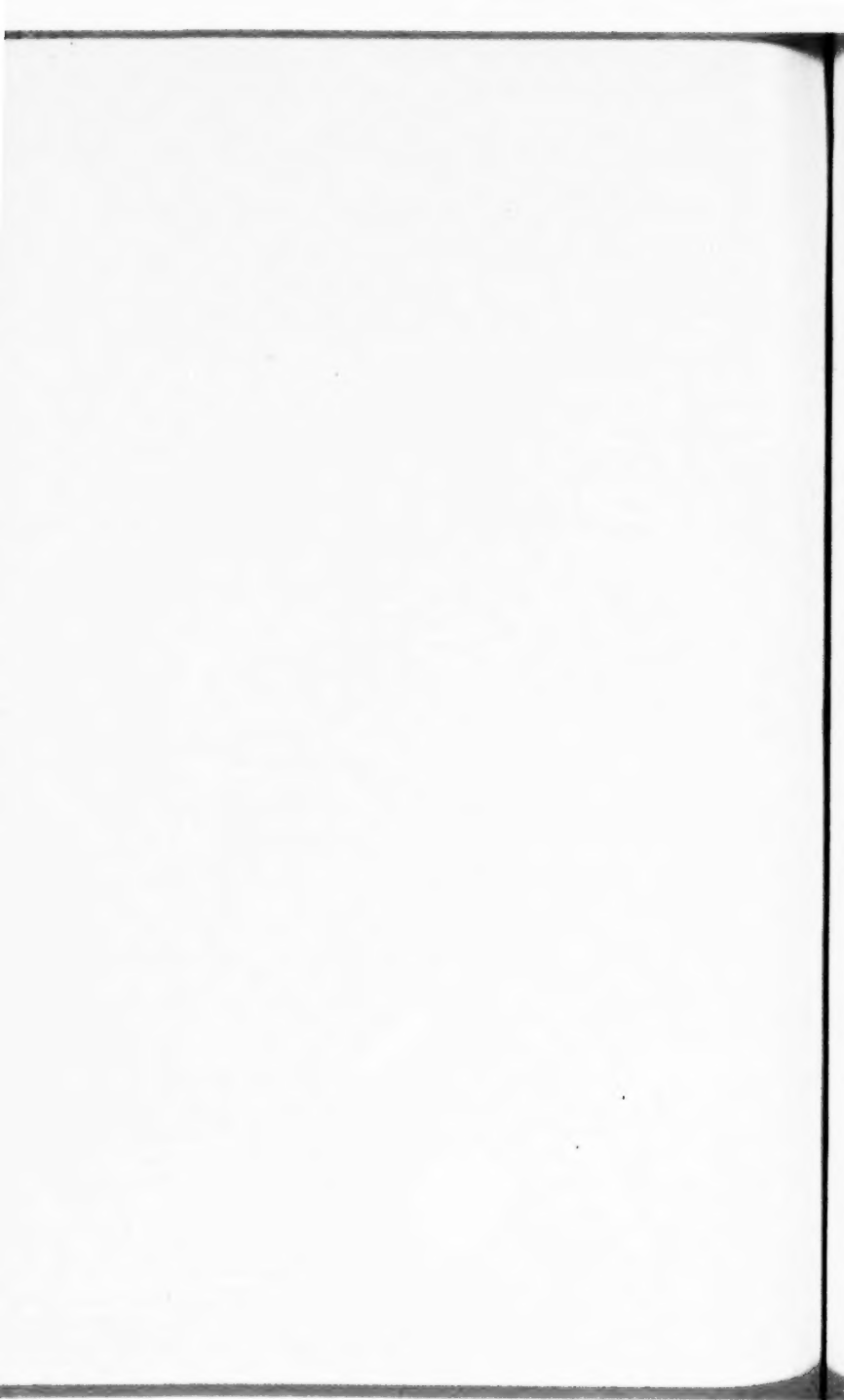
No. 168,359.

Patented Oct. 5, 1875.



WITNESSES
 Claudius S. Markov
 J. E. Boggs.

INVENTOR
 George Westinghouse
 by George H. Christy
 his Atty.



*Nos. 402 & 426
Westinghouse & Co. } p 1230
Dryden Co.*

2 Sheets--Sheet 2.

**G. WESTINGHOUSE, Jr.
Air-Valve for Power Brakes.**

No. 168,359.

Patented Oct. 5, 1875

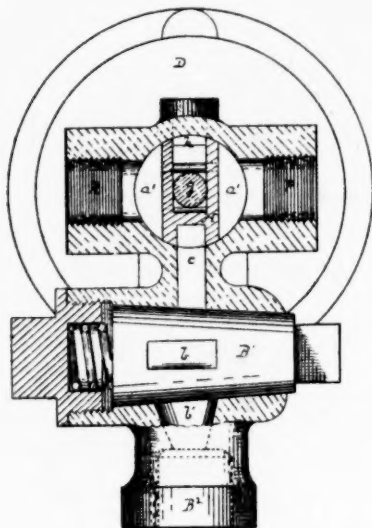


FIG. 2.

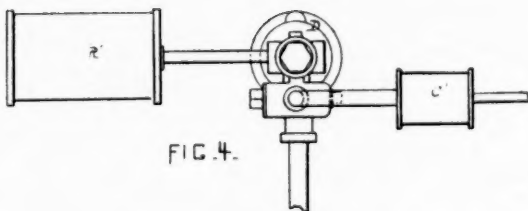


FIG. 4.

WITNESSES.

*Claudius L. Barker
J. C. Bogge.*

INVENTOR

*George Westinghouse Jr.
by George H. Christy
his Atty.*



One end of the stem d^4 passes through a suitable aperture in the cap D^1 and enters the piston-chamber a , and the other end is guided in the tubular aperture of the bush d^1 .

From the valve-chamber a^1 a side port, R , leads by suitable pipe connections to an auxiliary reservoir, R' , of the usual or any suitable construction. In this chamber is a slide-valve, H , from beneath which a port, e , leads through a bracket-arm, B , in which is formed a cock-case, and through a cock, B' , arranged therein by a port or passage to a coupling, C , from which, by suitable connections, communication is effected with the usual brake-cylinder C' . Another port, e^1 , leads from the valve-chamber a^1 to the external air, and these ports e e^1 are in such proximity at their valve-chamber ends that they be brought into communication, or one cut off from the other, by the movement of the valve H . This valve is kept from revolving by means of a pin, h , entering a groove in its back or top, or by other suitable means, and is fitted with any desired known appliances for adapting it the better for its work.

The piston-chamber a contains a piston, G , suitably packed by a leather or metallic ring or rings, i , such as will give a close joint and work with small friction. From its upper side a stem, g , leads to and carries the valve H , and the upper extended end h' of the stem is guided, if need be, in a tubular socket made in the upper cap D^2 , which closes the upper end of the case D . Hence the valve H is operated by the piston G . The lower face of the piston has a V-shaped seat, v , which, at the lowest possible point of the down-stroke of the piston G , seats on a rubber seat, v' . On the upper side of the piston G I make an annular valve n , and a seat, n' , on the case, so that these shall come together and close direct through-communication, or prevent leakage when the piston G is at its highest point of stroke. When in this position, however, it

1232 uncovers a port, s , which is made in the case D , so as to make an open communication from one side of the piston to the other. The air passing through this port then enters the space a^4 above the piston, and thence passes by one or more radial ports, s^1 , into the annulus s^2 , and thence along the communicating passage a^2 , and out by the port R , to the auxiliary reservoir R' .

The introduction of compressed air from the brake-pipe is effected by suitable pipe-connection through the coupling B^2 . A port, b^1 , leads thence by a groove, b^2 , in the face of the plug B^1 to an air-passage, b^3 , made along the side of the case D , which passage, b^3 , opens into the annular groove c . The plug or cock B^1 is made to revolve in its case or seat, for purposes presently to be explained. The arrangement of its communicating passages being shown, its construction in other respects is such as is well known in the art. The coupling-port shown at P is simply made for convenience, and is to be closed by an ordinary screw-plug.

The devices thus described are arranged on each car with an auxiliary air-reservoir, R^1 , for containing compressed air stored up and ready for use, and also with a brake cylinder, C^1 , for applying the power by the usual piston and stem. When used as a part of the automatic apparatus the cock B^1 is kept in the position shown.

The engineer by his pump keeps up the desired air-pressure, and allows this pressure to be transmitted back, so that entering the coupling B^2 it shall pass, by the ports and passages $b^1 b^2 b^3 c e^1 a^3$, into the piston-chamber a , and by its pressure on the under side of the piston G shall seat it upward, as shown, and at the same time bring the valve H into the position shown. The compressed air, while still holding the valve G up, will pass, by the ports and passages $s a^4 s^1 s^2 a^2 R$, into the auxiliary reservoir R^1 , so as to charge it and keep it charged at a working pressure. The valve H at the same time covers the ports $e e^1$, so that none of the compressed air thus introduced can escape through either; but such ports $e e^1$ being then and thereby brought into communication, any air in the brake-cylinder C' above atmospheric pressure will escape, by $C e^2 b e e^1$, to the external atmosphere. The brakes will then be off, and the train in running condition.

Now, to apply the brakes with full force, the engineer, by opening a cock or valve in the brake-pipe, reduces the air-pressure therein, say, fifteen pounds per square inch, more or less. The pressure is then reduced in chamber a to a corresponding amount. Back pressure from auxiliary reservoir R^1 then depresses the piston G , so as to pass and cut off the supply-port s , and shifts the valve H , so that it shall uncover the port e , but cover e^1 . Then the stored-up air in R^1 will pass the end of the valve H , and, by the ports and passages $e b e^2 C$, will go to the brake-cylinder C' , and by shifting the piston therein apply the brakes in the usual way. By restoring the pressure in the brake-pipe the engineer shifts the piston G up again to its upper seat, so as to reopen the line of supply-ports, and shifts the valve H to the position shown, so as to cut off communication from the auxiliary reservoir to the brake-cylinder, but open communication from the latter to the external atmosphere, as already described. The brakes are thus released. When the engineer wishes to apply the brakes with less than the maximum power he reduces the air-pressure in the brake-pipe a correspondingly less amount.

The position of the piston G in its chamber a is regulated chiefly by variations of air-pressure on its opposite sides, and by lessening or increasing slightly the air-pressure in a below the piston the position of the piston may be changed at pleasure, and with it, of course, the valve H .

It will be observed that the valve H has at h^2 a length and breadth of face such that it may entirely cover the port e . Hence the piston G may be brought down so that while entirely closing the supply-port s it shall bring the valve H to a position where it shall uncover only a small part of the port e , or any desired part. Then as soon as the desired amount of air-pressure has passed through e to the brake-cylinder a slight upward movement imparted to the piston G will cause the valve-face h^2 to cover entirely the port e , and remain in that position, so that the air already thus admitted to the brake-cylinder will be retained there, and the brakes will be held to the wheels with a corresponding force. By again lowering the piston G and with it the valve H this force may be increased by an

additional charge of compressed air; or by a farther upstroke the ports e and e^1 may be brought into communication, and the brakes so be released.

In order to render this operation of graduating the air-pressure in the brake-cylinders more easy and certain I employ the stem d^4 and spring d^2 , with a degree of power in the spring approximately equal to the weight and friction of the piston and valve, and so arranged that when the desired amount of air-pressure has passed into the brake cylinder through the port e , and the air-pressure on the piston G is about the same above and below, the spring and stem will almost instantly shift the valve H so as to cover the port e and retain the pressure in the brake-cylinder. For practical purposes I deem it best that the stem d^4 should be of such length that the piston will engage it when the slide-valve H covers the port e , so as to cut off the supply of compressed air to and exhaust from the brake-cylinder. This pressure may then be increased or decreased at pleasure in the manner already described.

As water is sometimes condensed in the operations described, I provide for getting rid of it by a drain-port, g , and a drip-cup, g' , screwed onto the lower end of the bush d^1 .

1233 & 1234 As it sometimes happens that a car fitted up with the automatic apparatus is on a connecting line, made up into a train, the other cars of which are furnished with apparatus substantially such in some or all material features as that described in patent granted me April 13, 1869, it is important to convert the former into the latter. For this purpose I use the cock B^1 . By turning it, as in Fig. 3, so that the port or groove b shall communicate at its opposite ends with the ports e^2 and b^1 , it will be seen that all the rest of the apparatus will be effectually cut off, and a direct passage-way be made from the brake-pipe to the brake-cylinder. The compressed air is then turned on and turned off in applying and releasing the brakes in the manner generally practiced in that system of apparatus. Also, as it sometimes happens that the brake apparatus of a car will get out of order, so as to be inoperative, I provide for cutting off such car in such emergency by bringing a full side of the cock B^1 opposite the port b^1 , which will prevent all ingress of compressed air; and in detaching a car from a train where the automatic brake is in use I provide against the application of the brakes by leakage or escape of the air from the chamber a by means of the same cock B^1 . For this purpose I shift it to the position shown in Fig. 3, or to any other position which will prevent the air in the reservoir R' from being charged into the brake-cylinder C' ; and for the purposes described any suitable form of four-way cock may be substituted, in combination with the same, or a substantially-like arrangement of ports.

The forms of the valves, ports, and communicating-passages, and to a certain extent their arrangement, may be changed, and all such modifications of the apparatus described as include a piston and slide-valve, operated by air-pressure, for charging alternately and successively an auxiliary air-reservoir and brake-cylinder, and do not materially depart in their combinations and modes of operation

from what is above set forth and hereinafter claimed, I hereby include as within the scope of my invention. Also, the reversible cock B' , with an arrangement of ports substantially such as described, may be used in connection with the automatic triple valve now in common use, or other like apparatus, the combination and function remaining in this respect substantially the same.

One reason for using and preferring a slide-valve, H , which may be of any known suitable construction, instead of a piston-valve, is that the former does not require any packing, and may be worked with less friction. I have found that any considerable amount of friction interferes seriously with that ready, accurate, and certain motion of the valve which is required in this kind of a device for the purpose set forth.

I claim as my invention—

1. In an air-brake apparatus, a moving piston arranged in the line of air communication, operated by air-pressure, and a slide-valve, H , connected therewith, in combination with suitable air ports and passages leading to an auxiliary reservoir and brake-cylinder, whereby such reservoir and cylinder will be charged with compressed air alternately and successively by the throw or motion of the piston and valve, substantially as set forth.

2. The port s , in combination with air chamber a , piston G , slide-valve H , and auxiliary reservoir and brake-cylinder ports, arranged substantially as set forth.

3. The slide-valve H , in combination with an air-reservoir and brake-cylinder, arranged and operative substantially as set forth.

4. In combination with the piston G , a suitable line of ports and passages, $s\ a^4\ s^1\ s^2\ a^2$, for supplying compressed air to the auxiliary reservoir while the piston is on its upper seat, substantially as set forth.

5. In combination with a piston, G , operated by air-pressure, a stem d^4 , and spring d^2 , substantially as set forth.

6. The port q in an apparatus substantially such as described, for draining off the water of condensation from the air chambers or spaces to a drip-cup, q' .

7. A reversible four-way cock, in combination with a single line of charging-pipe and supply-port therefrom, a brake-cylinder port, and ports leading to and from suitable automatic devices, substantially as set forth, whereby either of the modes described of operating the brakes may be employed at pleasure without changing the port of supply.

8. An arrangement of ports $b\ b^1$ in the cock B' , ports b^3 and e , communicating with the automatic apparatus, and ports $b^1\ e^2$, communicating with the brake pipe and cylinder, substantially as set forth.

In testimony whereof I have hereunto set my hand

GEORGE WESTINGHOUSE, JR.

Witnesses:

JOHN D. MORELAND.

S. HOWARD SPRAGUE.

G. WESTINGHOUSE, Jr.

AIR-BRAKE VALVE.

No. 172,064.

Patented Jan. 11, 1876.

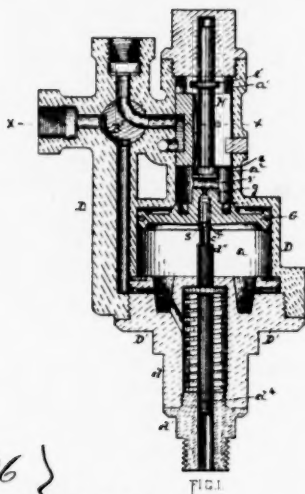


FIG. 1

No. 4031426 }
Westinghouse Co. p 1236
v.
Fryden Co.

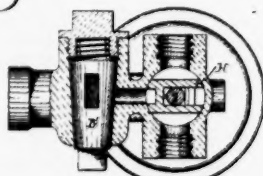


FIG. 2

WITNESSES.

Claudius A. Parker
J. E. Briggs.

INVENTOR

George Westinghouse Jr.
by George N. Christy
his Atty.

GEORGE WESTINGHOUSE, JR., of Pittsburg, Pennsylvania.

Improvement in Air-brake Valves.

Specification forming part of Letters Patent No. 172,064, dated January 11, 1876; application filed December 18, 1875.

To all whom it may concern:

Be it known that I, George Westinghouse, Jr., of Pittsburg, county Allegheny, State of Pennsylvania, have invented or discovered a new and useful improvement in air-brake valves; and I do hereby declare the following to be a full, clear, concise, and exact description thereof, reference being had to the accompanying drawing, making a part of this specification, in which—like letters indicating like parts—

(Here follows diagram marked p. 1236.)

Figure 1 is a longitudinal sectional view of my improved valve; and Fig. 2 is a transverse sectional view through the line *x x*, Fig. 1. My present invention relates to an improvement in the valve device patented to me October 5, 1875, by patent No. 168,359. It is intended for the same purpose as therein set forth, performs the same function, and includes only such changes in construction and operation as hereinafter set forth.

The valve-case D is the same, inclosing a like piston chamber, *a*, valve-chamber, *a*¹, and communicating passage *a*²; also the screw-cap D', with its air grooves and ports, and tubular extension *d*, and stem-guide *d*¹; also the stem *d*², with its collar and spring; also the piston G, with its stem *g*, valve H, cock B', and the passages and ports which lead from and to such valve and cock, and from and to an auxiliary reservoir, brake-cylinder, and brake-pipe.

All these devices, having by the prior patent become a part of the prior state of the art, need not here be more fully described.

My present improvement dispenses with the side port *s* in the valve-case, and provides for an air-port (herein also lettered *s*) directly through the piston G, with one or more lateral ports *s*¹, opening into the passage *a*². The end of the port *s* next the chamber is made large enough for the insertion of a stem, *c*, of a somewhat less diameter, such stem *c* being connected by an enlargement, *c*¹, to the end of the stem *d*². The smallest part *c* of this compound stem is of the diameter of the smaller part of the port *s*, (or preferably a little less,) so that as the piston G makes a downstroke, *c* will enter the smaller part of *s*, and clean out any dust, dirt, or other obstruction which may have lodged therein.

The enlargement *c*¹ of the compound stem is of such length, size, and position relative to the piston G and the adjacent end of the port *s* that when the devices are in the position shown, (the brakes

then being "off" and the train in running condition,) such s will be open for the free passage of air from the brake-pipe to the auxiliary reservoir; but with a diminution of air-pressure in chamber a the back pressure of air from the auxiliary reservoir will shift the piston G, so that the port s , slipping onto the enlarged part c' , will be closed thereby, and the escape of air cut off in advance of the opening of the communication from the auxiliary reservoir to the brake-cylinder; and that this may be done without having to overcome any resistance from the slide-valve H, I make the distance between the collars e and e' a little greater than the length of the valve, as shown. Hence the port s will be closed before valve H begins to move for applying the brakes, and will be closed until the valve H shall have been brought back to the open position for a full release of the brakes. Consequently the valve can be operated as may be desired in applying and releasing brakes, and in graduating the brake-pressure, without leakage or loss at the air-supply port s , and with such port always closed.

As the piston G continues its stroke it engages the end of part d^4 of the compound stem, with the operation and result shown in the patent above cited.

It is not necessary that the port s should be of a reduced size at any point; but I prefer to make it as small as practicable for applying the amount of compressed air desired, in order that there may be as small an escape as possible when the back pressure on the piston G is brought into effective operation.

I claim herein as my invention—

1. The sliding piston G, having an air-port s , closed and opened by sliding onto and off of a stem, c' , and in combination therewith substantially as set forth.

1238 2. The sliding piston G, having an air-port, s , in combination with the compound stem c and c' d^4 , substantially as set forth.

3. The slide-valve H, made shorter than the distance between end bearings, in combination with the port s and stem c' , relatively arranged with reference to the operation of the valve H, while port s is closed, substantially as set forth.

In testimony whereof I have hereunto set my hand.

GEORGE WESTINGHOUSE, JR.

Witnesses:

JAMES M. CHRISTY.

GEORGE H. CHRISTY.

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Nos 403 & 426.
Westinghouse & Co. } *p. 1240*
Eng'rs

G. WESTINGHOUSE, Jr.
Automatic-Brake Relief-Valve.

No. 217.838.

Patented July 22, 1879.

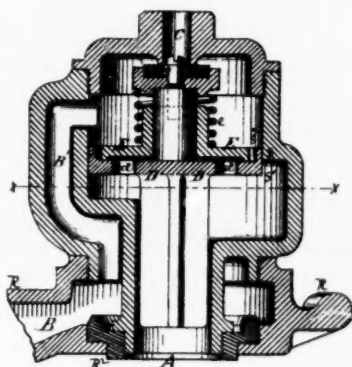


Fig. 1.

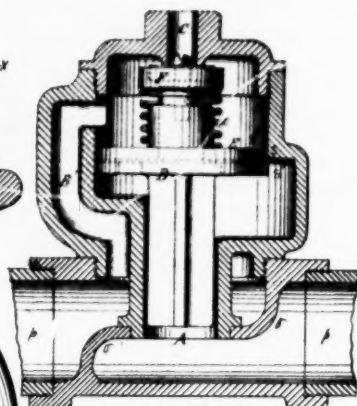


Fig. 3.

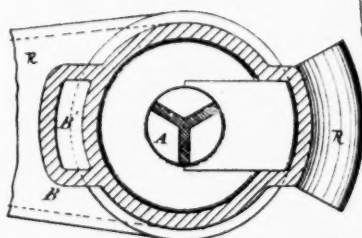


Fig. 2.

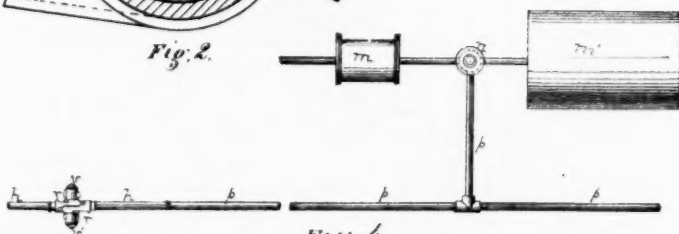


Fig. 4.

Witnessed
Amos L. Clark
Claudius L. Barker

Inventor *George Westinghouse, Jr.*
By Attorney *George H. Christy*

GEORGE WESTINGHOUSE, JR., of Pittsburg, Pennsylvania.

Improvement in Automatic-brake Relief-valves.

Specification forming part of Letters Patent No. 217,838, dated July 22, 1879; application filed May 21, 1879.

To all whom it may concern:

Be it known that I, George Westinghouse, Jr., of Pittsburg, county of Allegheny, State of Pennsylvania, have invented or discovered a new and useful improvement in automatic-brake relief-valves; and I do hereby declare the following to be a full, clear, concise, and exact description thereof, reference being had to the accompanying drawings, making a part of this specification, in which—like letters indicating like parts—

(Here follows diagram marked p. 1240.)

Figure 1 is a vertical sectional view of a relief-valve applied to and combined with a coupling of the class described in reissued patent No. 8291, granted to me June 18, 1878. Fig. 2 is a horizontal section thereof through the line xx of Fig. 1. Fig. 3 is a vertical sectional view, showing the relief-valve applied directly to a ported diaphragm in the pipe; and Fig. 4 shows in outline the main elements of an automatic brake of the kind or class to which the present invention is particularly applicable.

The present device is more especially designed for use with and as a part of brake apparatus of the class commonly represented by the Westinghouse automatic brake, in which the brake-power available for immediate use in the brake-cylinders is contained in auxiliary reservoirs, one under each car. The brake-pipes are also kept full of air under pressure, in order to keep the reservoirs fully charged, and the charge of compressed air in the auxiliary reservoirs is brought into action in the brake-cylinders by opening an escape-port leading from the brake or communicating pipes to the external air. A like effect follows when the train separates, or couplings become disconnected, or other accident ruptures or opens the air-conduit pipes. The brakes are then automatically applied.

Such an apparatus is partly shown in outline in Fig. 4, wherein m represents one of a series of brake-cylinders; m' , an auxiliary reservoir. n is the valve which governs the flow of compressed air from reservoir to cylinder, and from cylinder to escape. $p p$ are the brake-pipes; h , the hose, and r the couplings. The main reservoir and operating-cock on the locomotive are of the usual construction. The relief-valves are represented at $v v'$.

It sometimes happens with such brake apparatus, especially in case of accident, that material advantage could be effected by having all the brakes of the train applied or brought into action simul-

taneously, or as nearly so as possible. To accomplish this it is only necessary to make provision for the simultaneous opening of one or more ports in the air-conduit passages at points not remote from each auxiliary reservoir. For this purpose I arrange at such various parts of the air-conduit or communicating pipes as may be desired, but by preference at the couplings, relief-valves of the kind shown in the drawings. In the construction there shown the valve-box forms a part of the coupling itself.

The aperture A of the valve-box is seated in the lateral port-opening of the coupling R, so as to come in the line of the flow of air through the brake-pipe, hose, and couplings.

The aperture A communicates with the port of the next half-coupling, and the aperture B leads to hose and brake-pipe. A third aperture, C, opens to the external air.

Within the valve-box is a piston, D, with holes *d* through it, covered by a valve, E, held down by a spring, *e*. On the stem of the piston is fixed a valve, F, which covers the aperture C.

When compressed air enters the valve-box by the aperture A from the front portion of the communicating pipe, it raises by its pressure the valve E, passes through the holes *d* in the piston D, keeps the valve F closed, and passes on by the passage B' and aperture B to the hinder part of the pipe to charge the auxiliary reservoirs, in the usual way. But should the pressure in the front part of the pipe communicating with A be reduced intentionally or by accident, then, the valve E closing the holes in the piston D, that piston is pressed down by the pressure from B, and the valve F is drawn from its seat, leaving the orifice C open for the escape of air from the hinder portion of the pipe which communicates with B; and by giving the piston D and valve E a sufficient length of stroke or motion, such that it will drop below the shoulder *s*, an open passage-way will be formed for the escape of fluid-pressure from the enlarged space or port *s*¹ to *s*², and thence out at C. In this
1242 way provision is made for the escape of fluid-pressure through C from the brake-pipes both forward and back of the couplings.

By arranging such valve-boxes at several points along the communicating pipe, each section of that pipe becomes relieved from pressure almost immediately on the section in front of it being relieved, and consequently the several sets of brakes throughout the train are put in action without the loss of time which would be involved if, for the relief of pressure throughout the pipe, the air contained in the hinder portions of it had to flow all the way to the escape-aperture, which might be near its front part, and is usually on the locomotive.

The same device may be applied at any part of the communicating pipes *p* by making therein, across the bore of the pipe, a ported diaphragm, *o*, Fig. 3, such as is used in ordinary stop-cocks, and arranging therein a relief-valve of the construction described, as shown in said Fig. 3; and so far as relates to the relief-valve, the ported diaphragm *o* and the ported part R² of the coupling are the mechanical equivalents each of the other. The form or construc-

tion of the relief-valve, its function and operation being substantially retained, may be varied considerably, in so far as it is an element in the described combination, without any material departure from the scope of the invention.

I am aware of the prior use of escape-valves, in combination with brake-cylinders, for the purpose of effecting a reduction of the working-pressure in such cylinders; but in the present invention the escape-valve enters into combination not only with the brake-cylinder, but also with the auxiliary reservoir, and in such a manner as to secure a result the reverse of that just stated—viz., to facilitate the charging of the compressed air from the auxiliary reservoir into the brake-cylinder.

I claim herein as my invention—

1. In combination with the brake-cylinders and auxiliary reservoirs of an automatic-brake apparatus, a ported diaphragm arranged in the line of fluid-pressure communication, and a valve device, which, under operative fluid-pressure, closes the external air or escape port, and opens a through passage-way for the air, and on the reduction of air-pressure in the main air-conduit, by accident or otherwise, will open the escape-port, substantially as set forth.

2. A relief-valve applied directly to and made as a part of a coupling, the combination of such two elements being substantially as described.

3. The valves E F, and ported piston D, in combination with ports or ways A B C, substantially as set forth.

In testimony whereof I have hereunto set my hand.

GEORGE WESTINGHOUSE, JR.

Witnesses:

CHAS. BERKLEY HARRIS,
17 Gracechurch Street, London, E. C.
JNO. DEAN,
17 Gracechurch Street, London, E. C.

GEORGE WESTINGHOUSE, JR., of Pittsburg, Pennsylvania.

Improvement in Regulating-valves for Automatic Brakes.

Specification forming part of Letters Patent No. 220,556, dated October 14, 1879; application filed September 17, 1879.

To all whom it may concern :

Be it known that I, George Westinghouse, Jr., of Pittsburg, county of Allegheny, State of Pennsylvania, have invented or discovered a new and useful improvement in regulating-valves for automatic brakes; and I do hereby declare the following to be a full, clear, concise, and exact description thereof, reference being had to the accompanying drawings, making a part of this specification, in which—like letters indicating like parts—

(Here follow diagrams marked pp. 1244 & 1246.)

Figure 1, sheet 1, is a vertical sectional view of the triple-valve device illustrative of my improvements. Fig. 2 is a transverse horizontal section in the line *xx* of Fig. 1. Fig. 3 is a detached sectional view of the slide and auxiliary valves, valve seats, and stems, as shown in Fig. 1, but with the auxiliary valve in a different position; and Fig. 4, sheet 2, by a view similar to Fig. 1, illustrates some modified features of construction.

In the class of fluid-pressure brakes for railway-trains commonly known in this country as "automatic brakes," a device usually termed a "triple valve" is extensively used. This device, in two of the many forms in which it has been patented, is shown and described in United States patents granted to me October 5, 1875, No. 168,359, and January 11, 1876, No. 172,064, as well as in various other earlier and later patents.

It is important in such device that the valve (lettered H in said two patents and herein) which governs the flow of air or other fluid shall move not only with great certainty to any desired position, but also shall move with slight variations of pressure on the piston, (lettered G,) so that the application of the brakes with any desired power, and their ready release, may be quickly and easily effected at the pleasure of the engineer.

To this end I combine with the said valve H, giving it a slight range of motion on its stem, an auxiliary valve operated by the same stem, in such manner that a portion of the functions performed in said patents by the valve H may now be performed by such auxiliary valve, the latter moving with practically no resistance, and hence moving more quickly and with less pressure than the valve H itself. The same auxiliary valve is also designed for use, under certain circumstances, as a leakage-valve. In the drawings I have shown it as applied to or embodied in a triple valve

No. 403426.
Westinghouse & Co. p. 1244
Dryden Co.

2 Sheets—Sheet 1.

G. WESTINGHOUSE, Jr.
 Regulating-Valve for Automatic-Brakes.
 No. 220,556. Patented Oct. 14, 1879.

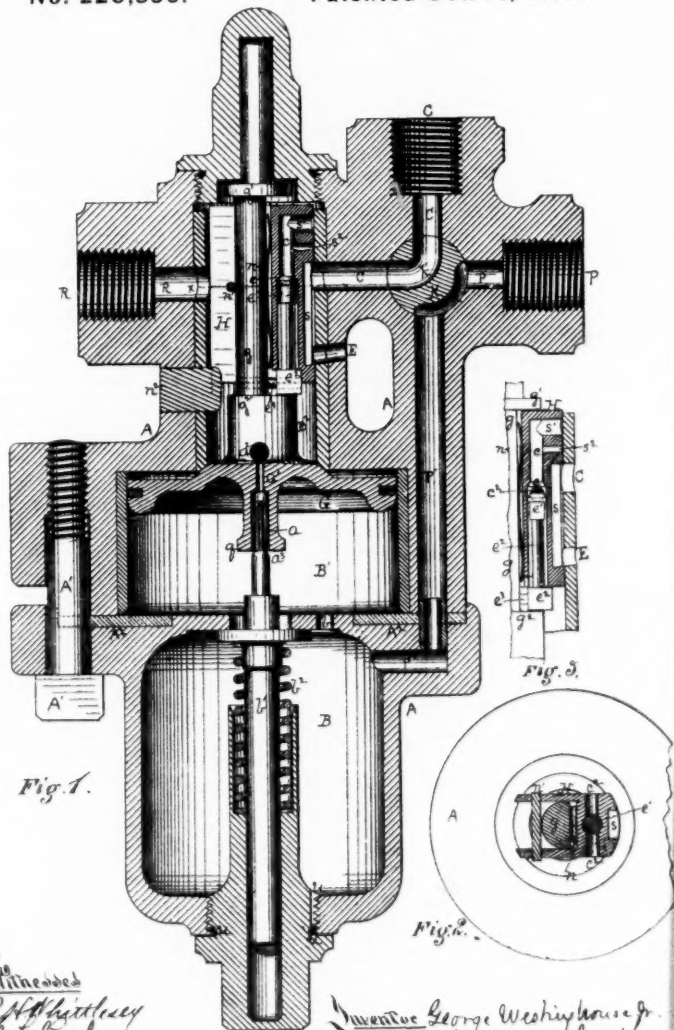


Fig. 1.

Fig. 2.

Wm. H. H. H. H.
R. H. H. H. H.
C. L. Parker

Invented by George Westinghouse, Jr.
 By Attorney George H. Christy



No. 403426.
Westinghouse & Co. } p. 1246
Poyden Co.

2 Sheets—Sheet 2.

G. WESTINGHOUSE, Jr.
 Regulating-Valve for Automatic-Brakes.
 No. 220,556. Patented Oct. 14, 1879.

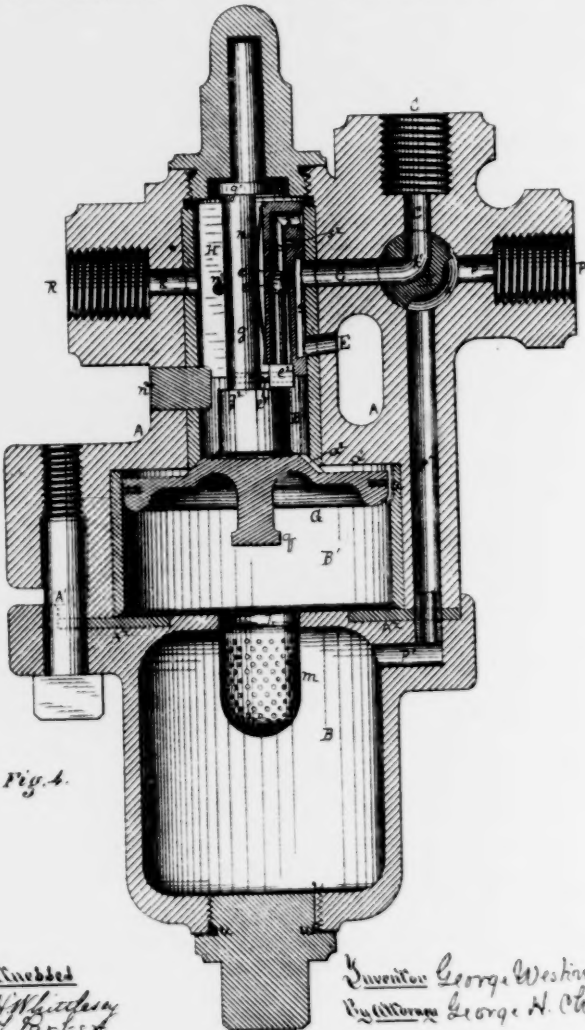


Fig. 4.

Witnessed
R. H. H. H. H.
E. L. Parker

Inventor *George Westinghouse Jr.*
 By *Attorney George H. Cluney*



having the graduating-stem and spring of said patents, and also as used without them. The former will be first described with reference to Figs. 1 to 3.

A represents the valve-case, made preferably in two parts, united by the necessary number of screw-bolts A^1 , with interposed packing A^2 .

B is a drip-chamber; B^1 , the cylinder in which the piston G is operated, and B^2 is an upper chamber, through which the fluid passes under pressure to the auxiliary reservoir by the port R, or to the brake-cylinder by the port C. It is also a valve-chamber for the slide-valve H, which is secured on the stem, in any suitable way, by a pin, n^1 , going through the back U-shaped wings of the valve, and is held to its seat by any suitable spring, as at n , and rotation on the stem is prevented by a stud, n^2 .

A cock, K, with ports $k k'$, is arranged in the line of fluid-pressure communication, substantially as represented, and for purposes which will be understood by reference to said patents.

From the port P connection is made with the brake-pipe, and from the port C with the cylinders. With the devices in the position shown in Fig. 1 the brake apparatus is in the normal condition for the running of the train. The fluid-pressure then enters the port P, passes by $k P'$ into chamber B, through port b into B^1 beneath the piston G, and holds the latter up in the position shown. It then passes through ports $a a^1 a^2$ into chamber B^2 , and thence to the auxiliary reservoir through port R.

The details of construction and the functions of these parts will be readily understood from the drawings and the patents above named.

The graduating-stem b^1 and spring b^2 , including the reduced upper end of the stem, have also the construction and operation described in the second of said patents.

The piston-stem g operates the valve H; but the collar g^1 and shoulder g^2 , which bear on the opposite ends of the valve or
1248 its connections and give it its motion, are a little farther apart—say about one-eighth ($\frac{1}{8}$) of an inch, more or less—than the distance between the end bearings of the valve H.

The distance between the open end of the port a and the shoulder a^3 on the stem b^1 , when the piston G is at the highest point of its stroke, is by preference somewhat less—say one-sixteenth ($\frac{1}{16}$) of an inch, more or less.

The valve H has a cavity, s , long enough to uncover the port C and the exhaust-port E and put them in communication. It has also two additional ports, $s^1 s^2$, the former having a diameter, by preference, of about three-sixteenths ($\frac{3}{16}$) of an inch, and the latter of about five-sixty-fourths ($\frac{5}{64}$) of an inch, in a device of the proportions shown; but I do not confine myself in my invention to these exact figures or proportions, but include all such variations therefrom as give substantially a like construction and operation.

The distance between the ports s and s^1 is equal to or slightly in excess of the diameter of the port C at the valve-seat. The port s^1 communicates by a passage, c , with the open end of the valve H.

Transverse to this passage, and opening therein, is a cross-port, c^2 , Fig. 3, extending to the exterior of the valve H on one or both sides. Between the point of junction of this port with the passage c and the port s^1 , I make a valve-seat, e , and seat thereon a valve, e^1 , the stem e^2 of which is connected by a pin, e^3 , with the stem g .

It will now be seen that any motion imparted to the piston G, Fig. 1, will, through the stem g , be first operative in unseating the valve e^1 , the valve H being held by frictional contact with its seat, so that the stem g will slide through it until the collar g' engages the upper end thereof. Also, after any portion of an up or down stroke is made by the piston G, the first motion thereof in an opposite direction will first shift the auxiliary valve e^1 to or from its seat, as the case may be, before any motion is imparted to the valve H.

In order now to apply the brakes fluid-pressure is allowed to escape from below the piston G by the manipulation of the cock on the locomotive or other escape-cock. Fluid-pressure then acts back from the auxiliary reservoir on top of G, and forces it down, first closing the port a , and at the same time unseating the valve e^1 , and bringing the latter and the devices immediately connected therewith into the relative positions shown in Fig. 3. But a very slight reduction of pressure below G is required in order to do this. The downstroke of G is continued, shifting the valve H downward rapidly or slowly, until the port s^1 comes partly or fully into line with C.

The escape at E is then closed, and the ports and passages are open for fluid-pressure to pass from the auxiliary reservoir by R, c^2 , c , s^1 , and C to the brake-cylinder and cause the application of the brakes. In this motion of H, however, it should be noted that the small port s^2 is, while passing the open end of C, in communication with the exhaust E; but the amount of air thus escaping through a port so small is practically inappreciable, and does not interfere with the action described. When now the valve H is thus shifted, so that the port s , shall, to the extent of one-quarter or one-half its capacity, more or less, as is usual when less than a maximum braking force is desired, be thus brought into communication with the port C, and held there until the limited or desired amount of fluid-pressure shall have passed into the brake-cylinder, the auxiliary valve e^1 becomes available as a quick and ready means of closing the supply-port with certainty, without danger of opening the exhaust. To this end a very slight increase or excess of pressure below the piston G—much less, in fact, than is necessary to shift the valve H—will suffice to move the piston G and stem g far enough to close the valve e^1 on its seat e . All ports are thus closed by an almost instantaneous motion, and the brakes remain on with a force corresponding to the amount of pressure previously charged into the brake-cylinder.

In case a slight addition to the operative braking force is desired, either to compensate for loss by leakage or for any other reason, it may be secured by a slight downward motion of the piston G, such as will unseat the auxiliary valve e^1 . In this manner the graduating friction may be more advantageously performed than heretofore.

But the use of this auxiliary valve enables me to dispense entirely with the graduating stem and spring, and in this combination it is illustrated in Fig. 4, sheet 2.

With the valve H of the patents above named, if the graduating spring and stem were omitted it would be found that after the slide-valve H had been so far shifted in applying the brakes as to permit a moderate or limited quantity of fluid-pressure to pass from the auxiliary reservoir to the brake-cylinder, in such case the amount of power of fluid-pressure necessary to shift such valve part way back, and thus close the port leading to the brake-cylinder, and thereby hold or retain the limited amount or degree of pressure in the brake-cylinder, would frequently give such valve its entire throw and result in the release of the brakes. The important function of graduating would thus be to some extent interfered with, since it is desirable in the handling of a train to be able to admit into the brake-cylinders any desired amount or degree of fluid-pressure less than the maximum, and to retain or hold it there without material increase or diminution. This tendency of the valve referred to, to complete its back stroke under the circumstances named, results, in part, from the fact that the amount of force necessary to start the valve upward when the graduating-spring is not employed is frequently found to be more than enough to carry it to the end of its stroke after it is started. But with the explanation already given,

it will be seen that the necessity of giving a back stroke 1249 & 1250 to the valve H is wholly obviated, so far as relates to closing the ports and holding in the brake-cylinder any predetermined or limited amount of fluid-pressure, or to increase such pressure at pleasure, since, after the slide-valve H has been brought to the desired position, as set forth, a slight motion imparted to the piston G, and much less than would be necessary to start the valve H, will suffice to seat and unseat the auxiliary valve e' , and so hold or retain in the brake-cylinder any desired pressure previously charged therein, or permit the increase thereof at pleasure.

Another part of my invention relates to the use of the auxiliary valve e' as a leakage-valve. When a car is disconnected from the train and run onto a siding, the auxiliary reservoir and brake-pipes are still charged with fluid-pressure. Leakage from the pipes, where it is greatest, results in the depression of the piston G until the port s^2 comes wholly or in part opposite the port C. As the intermediate full face of the valve is insufficient to cover entirely the port C, (the auxiliary valve e' being now unseated,) the fluid-pressure from the auxiliary reservoir will pass out slowly through s^2 , s , and E, but about as fast as it will leak from the brake-pipes. Were it not for this port s^2 , or some other leakage device, the port s^1 would be brought into communication with the port C so as to apply the brakes slowly at first, but eventually with maximum force, and hold them on for a considerable time. This would be highly objectionable, as it would interfere with the shifting of cars and other like operations, or even the running of a car, in case the brake apparatus of such car were disconnected, which it is sometimes necessary to do.

By the same device I provide for unexpected or accidental fluc-

tuations of pressure slight in amount, such as are liable to occur while the pipes are connected and the train running, without danger of the brakes being applied thereto.

In Fig. 4 I have shown a strainer, *m*, arranged over the port leading from B to B¹, as a device to exclude or aid in excluding dust; also, in this figure, the ports from B¹ to B² are shown past the piston G instead of through it.

In both forms of the device I have shown a knob, *q*, projecting from the lower side of the piston G, as a device by which to get hold of the piston and pull it out, when necessary, for purposes of renewal, cleaning, or repairs. The necessity for this results from the fact that heretofore careless workmen have often used the graduating stem for this purpose, and in doing so have bent the stem and caused trouble in the working of the valve.

The function of the large chamber B is chiefly that of a drip-cup, and to discharge the drip a hole and groove are made at *u*.

While in order to make my improvements clearly understood I have described and specified the devices with some minuteness, still include herein known mechanical equivalents, or such substitutes for devices specified as involve a substantially like operation and result.

I claim herein as my invention—

1. In combination with the piston and stem of a triple valve, valve H, arranged on such stem, and having a short range of motion independent of such stem, in combination with an auxiliary valve operated by the same stem to close or open a port through the main valve without necessarily moving the main valve, substantially as set forth.

2. In a valve-case having a fluid-pressure-supply port, an auxiliary reservoir-port, a brake-cylinder port, and exhaust-port, a valve H, for governing the flow of air, provided with ports or passages *s* and *s*¹, and a fluid-pressure-supply port communicating with *s*², in combination with piston G, substantially as set forth with reference to the exhaustion without application of the brakes of the contained fluid-pressure.

3. The valve H, having cavity *s*, ports *s*¹, *s*², *c*, and *c*², in combination with valve *c*¹, substantially as set forth.

4. In combination with a triple valve of the class described, a strainer, *m*, arranged inside the valve-case and over or across the port leading to the piston-chamber, substantially as set forth.

In testimony whereof I have hereunto set my hand.

GEO. WESTINGHOUSE, JR.

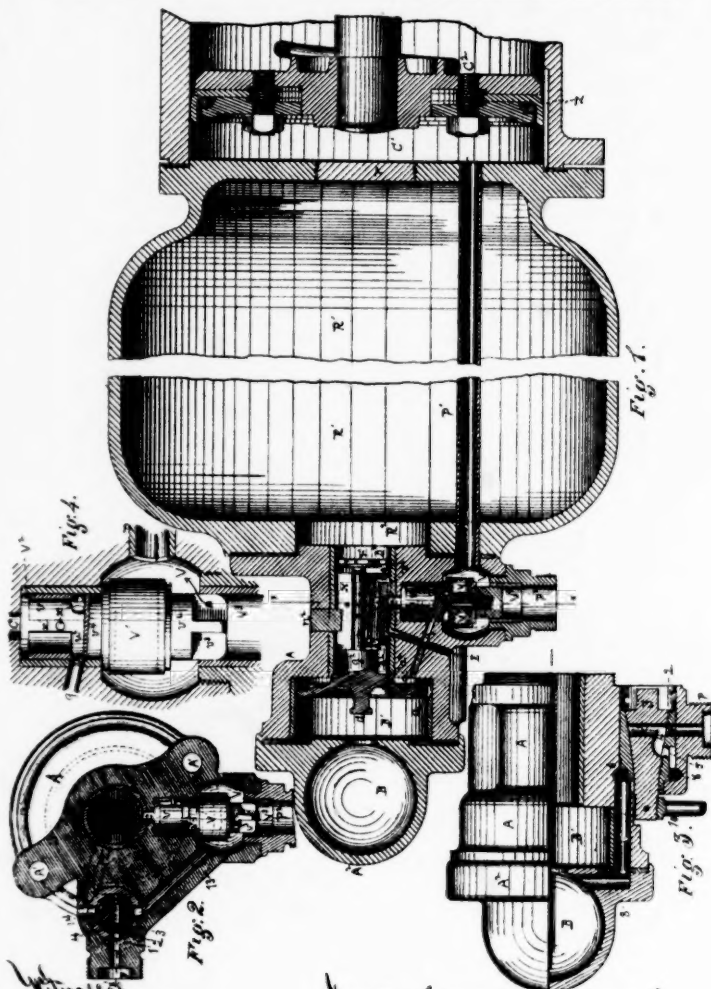
Witnesses:

R. H. WHITTLESEY.
GEORGE H. CHRISTY.

Nos. 403 & 426.
Westinghouse Co. } p. 1252
Boyd Co.

No. 235,922.

Patented Dec. 28, 1880.



Witnessed
J. H. Maitland
Henry S. S. S.

Inventor George Vestinghouse Jr.
By Attorney George H. Minnity

1253

UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., of Pittsburg, Pennsylvania.

Fluid-pressure Brake.

Specification forming part of Letters Patent No. 235,922, dated December 28, 1880. Application filed November 15, 1880. (No model.)

To all whom it may concern :

Be it known that I, George Westinghouse, Jr., of Pittsburg, county of Allegheny, State of Pennsylvania, have invented or discovered a new and useful improvement in fluid-pressure-brake apparatus; and I do hereby declare the following to be a full, clear, concise, and exact description thereof, reference being had to the accompanying drawings, making a part of this specification, in which—like letters indicating like parts—

(Here follows diagram marked p. 1252.)

Figure 1 is a sectional view of so much of a brake-cylinder, auxiliary reservoir, and air-regulating valve and connections as is necessary in order to illustrate my present invention. Fig. 2 is a cross-section in the plane of the line *x x*, Fig. 1. Fig. 3 is a section of one-half of Fig. 2 in the plane of the zigzag line *x'* to the center, and an outside elevation of the other half, and Fig. 4 is an enlarged view of the double check-valve of Fig. 1. As the moving parts of the triple-valve device (above termed "air-regulating valve") are well known in the art, I have shown them only in Fig. 1.

My present invention relates to certain improvements in the construction and combination of appliances to be used in and as a part of fluid-pressure-brake apparatus for railway use, and while it is especially adapted for use in what is commonly known as "automatic-brake" apparatus, I also so construct it that it may be used in the non-automatic system of construction and operation—that is, where the fluid-pressure is conducted directly from the source or magazine of power to the brake-cylinder whenever the brakes are to be applied, and on the opening of a cock or valve by the engineer for that purpose. In the automatic system, on the other hand, the fluid-pressure is commonly conducted from the main reservoir or source of power, and stored in auxiliary reservoirs on the several cars, and a valve device, shifted by variations in the air pressure, is arranged in connection with the apparatus in such manner as that, on the accidental or intentional reduction of fluid-pressure in any of the conduit-pipes, a port will be opened from each auxiliary reservoir to a brake-cylinder.

In my present invention I unite in what may be termed a "single structure" the brake-cylinder, the auxiliary reservoir, and the valve apparatus employed for giving proper direction to the flow of the fluid-pressure, and thereby I greatly simplify the construction, make it more compact and at a less cost, and, by dispensing with numerous joints, lessen the liability of loss by leakage, as well as render it

more durable; and by adding in the same combination another of pipe with suitable connections, valve, and ports, I make provision for switching out or cutting off the automatic features, so that a so fitted may be used with other cars having only the usual appliances for non-automatic operation, and all in a more simple manner than any described in my previous patents.

In the drawings, R' represents the auxiliary reservoir, and C' brake-cylinder, made so as to be secured together end to end. A hole in the dividing wall or diaphragm, made for convenience of casting, is closed by a plug, *r*. Holes are also made in the walls of the reservoir R', and a pipe, P', extends from one to the other, through which to convey the fluid-pressure to the brake-cylinder. The outer end of the pipe leads to a valve-chamber and its use will presently be described. The outer end of the reservoir R' has also a large open port, R², and over this port is secured by bolts through bolt-holes A', the valve-case A of what is commonly termed in the Westinghouse-brake system a "triple valve." This device, in consequence of various improvements, has practically ceased to be a triple valve; but as it is commonly known by that term the name may, for convenience, be retained. This device is substantially the construction and operation described in United States patent granted to me October 14, 1879, No. 220,556, and illustrated in Fig. 4 thereof, except that, instead of having a side port and pipe-connection leading to the auxiliary reservoir, the open end of the valve-case is directly opposite to and opens into port R², so that this communication is always open; also, the valve-stem *g*, having no end socket in which to be guided, as in the patent above named, is guided by a winged disk, *r'*, the wings of which play on the walls of the valve-chamber B². The other parts of this triple-valve device, so far as they are like those in the 1254 patent above named, are similarly lettered, and a reference thereto their construction and operation will be readily understood; but instead of the leakage port in that patent (lettered *s*²) in the slide-valve H, I carry a groove (here indicated by the same letter) to the port *s'*; but the operation is not substantially changed thereby. Other devices described in said patent No. 220,556, and not here shown, may be omitted or used, as preferred so far as the same are suitable for use in this construction.

The cap A² of the triple-valve case contains a chamber, B, which opens into the piston-chamber B'. The line of pipe through which fluid-pressure is transmitted for the automatic operation of the apparatus is connected at P. From this point a line of ports leads first, at 1, Fig. 3, into a cock-case, 2, wherein is a plug, 3, having a notch or recess, 4, through which the fluid-pressure passes to a port 5; thence into an annular chamber, 6; thence, by vertical and horizontal ports 7 and 8, into the chamber B. Through this line of ports fluid-pressure is introduced and let off, so as to operate the triple valve, as described in said patent No. 220,556; but for the non-automatic operation of the brakes I connect the fluid-pressure conduit-pipe at P². It will now be seen that this pipe-connection opens into the valve-chamber V on one side, and that the tri-

valve opens into the same chamber on the other side. In order to cut off at pleasure one line or the other of air conduit or communication, I arrange in this chamber a double check-valve, V' , which seats both ways. This double check-valve has a tubular extension, v , which slides like a piston inside the chamber V^2 . From this chamber a side port, g , leads to the escape-port E , or may lead directly to the atmosphere, and when these devices are in the position shown in Fig. 1, (which is the position for the non-automatic action,) a slit or port, u^2 , in the tubular extension v registers with this side port through port u in the bush or lining of the chamber. Other ports, u' , are also made in this tubular extension, for purposes presently to be explained. A pin, x , on which the tubular extension plays, by a slit, x' prevents the rotation of the extension. The opposite or outer end of the double-check-valve stem has a cylindrical part, v^2 , which, when the valve is shifted outwardly, fills the adjacent end of the bore of the chamber V^3 as soon as the opposite or automatic port is opened, and outside of this is a winged stem, v^3 .

Assuming now that the non-automatic system of operation is to be used, fluid-pressure, entering at the port P^2 , shifts the double check-valve V' over to the position shown, so as to cut off the automatic feature from the line of communication. The fluid-pressure then passes, as indicated by the arrows, Fig. 4, into and along the pipe P' , to the brake-cylinder C' , and there does its work in the usual way. If, then, at the same time, either accidentally, by design, or in consequence of leakage, any comparatively small amount of fluid-pressure should come through the triple-valve ports into the tubular extension v , it will at once pass out by the ports g and E ; but if it be desired to employ the automatic system of operation, the reservoir R' is charged, (if not already charged,) and on the reduction of the pressure in the brake-pipe the triple valve is shifted, so as to let the pressure pass from R' through the port R^2 , shift the piston G and valve H , so as to uncover the port C , and thence through this latter port into the tubular extension v . As the port u is too small to provide for its escape, it acts to throw the double check-valve V' outward and close the non-automatic port. This brings the holes u' and slit u^2 , made in the walls of the tubular extension v , outside the valve-seat at that end of the chamber, or, in other words, causes them to open into the valve-chamber V ; and it will be observed that this end of the valve-stem has a cylindrical port, v^4 , so that the ports u' u^2 are not uncovered until the cylindrical part v^2 on the other end of the valve shall have practically closed the non-automatic port. The fluid-pressure thus introduced passes by the pipe P' to the brake-cylinder, and also does its work in the usual way. The brakes may be released in the manner described in said patent No. 220,556.

The apparatus thus described I propose to use either as automatic or as non-automatic, with a single line of pipe; or, what is still better, I propose to use two lines of pipe, and use either method of operation at pleasure, or sometimes one and sometimes the other. For holding a long passenger or freight train in check on a long

downgrade, the non-automatic method of working is in some respects preferable, whereas for stopping purposes, particularly in an emergency, the automatic is much the better. Hence on roads in hilly or mountainous regions it is well to have both methods available, at the pleasure of the engineer, and in such use the automatic apparatus should always be kept charged and in a usable condition, so that it may be used or made available for an emergency stop, or in case of accident, as well as for ordinary stops, even while the non-automatic apparatus may be employed at intervals for certain purposes; but in case it should become necessary, as it sometimes does, to exhaust or discharge the compressed fluid-pressure from the brake-cylinder R' , it may be done by the turning of the plug 3 (a handle, 10, being added for the purpose) so as to bring the port 12 into line with the ports 13 and 14, Fig. 2, the former of which is in communication with the valve-chamber V , and the latter of which opens to the outer air. This necessity may arise when a car is detached from the train, and by the escape of air from the brake-pipe the brakes are set and remain so.

It is also an important and novel characteristic or feature of my present apparatus that I provide for the discharge of the 1255 & 1256 fluid-pressure from all the auxiliary reservoirs of the train by the use of a higher or a mechanically more effective pressure through the non-automatic pipe. Thus, in case of the bursting or breakage of any of the fluid-pressure conduits of the automatic apparatus, (which may occur while the train is at a place or point on the line where repairs are almost practically impossible,) the pipe-valves throughout the train are shifted, and fluid-pressure then passes from each auxiliary reservoir to its brake-cylinder, and all the brakes are set. Of course they can be released in the manner already described; but I deem it better in such cases to discharge the fluid-pressure from the auxiliary reservoirs, so that the brakes cannot in any contingency again be reset by a new charge from such reservoirs. To this end I pump up, if need be, and transmit back through the non-automatic pipe, a pressure sufficient to shift each valve V' , as against the pressure to which it may be subject from its auxiliary reservoir, so as to cause the port or slit u^2 to register with the port u , and thereby allow all the pressure in all the auxiliary reservoirs to escape through ports 9 and E to the open air. This being done, the brakes may be released in the manner common in the working of the non-automatic brake, and the train may proceed, using then the latter apparatus for braking purposes until damages are repaired; but in the operation thus described the plug 3 is presumed to be absent, or, if present, to be closed as regards the ports 13 and 14.

The plug 3 may be used to cut off the automatic apparatus entirely, when desired, by setting it so as to cut off all the ports leading into or through the same.

In order to guard against the effects of the leakage of fluid-pressure into the brake-cylinder, (when it occurs,) I make a small groove, z , in the interior of the cylinder, past the piston C^2 when it is at the end of its back-stroke, or when the brakes are off; and I make this

groove large enough to provide for the escape of so much fluid under pressure as is liable to leak into the cylinder, but so small that it cannot carry off an operative charge or quantity. As soon as the piston on its forward or outward stroke laps onto the outer end of the groove, the latter ceases to perform any function whatever.

In lieu of the specific form or construction of triple valve described, any other known form of device for regulating and governing the flow of fluid-pressure in a substantially like manner by the action of the fluid-pressure itself may be substituted without any substantial departure from the scope of the present invention, and such substitutes, performing a like function, I include within the term "triple valve," as hereinafter used; and, particularly, it may be stated that for some uses the triple valve may be arranged on one side of the reservoir R', instead of at its end, both arrangements thereof being included herein, and like variation may be made in the arrangement of the brake-cylinder.

I claim herein as my invention—

1. In a fluid-pressure-brake apparatus, a triple valve, auxiliary reservoir, and brake-cylinder arranged end to end in a single structure, without interposed pipes to connect one to the next, substantially as set forth.

2. The combination of a brake-cylinder furnished with a piston moving therein, arranged on one end or side of a reservoir, a triple valve arranged on another end or side, and a pipe connecting the triple valve with the brake-cylinder, substantially as set forth.

3. A valve-chamber, V, containing a double check-valve, in combination, by port C and pipe P', with triple valve, auxiliary reservoir, and brake-cylinder, substantially as set forth.

4. A double check-valve, V', having a ported tubular extension, v , thereon, in combination, by ports C, E, and G, with triple valve, substantially as set forth.

5. The double check-valve V', having cylindrical extensions v^1 and v^2 and ported tubular extension v , as a device for cutting off one of two different sets of fluid-pressure-brake apparatus while bringing the other into communication, substantially as set forth.

6. The cock and case having line of ports and passages 1, 4, 5, 6, 7, and 8, substantially as set forth.

7. The cock 3, in combination, by ports 12, 13, and 14, with chamber V and passages thence to auxiliary reservoir and brake-cylinder, substantially as set forth.

8. In a fluid-pressure-brake apparatus having automatic and non-automatic appliances and a pipe-connection for each, the method of discharging the fluid-pressure from the auxiliary reservoirs of the train, by charging through the non-automatic connection a pressure sufficient to shift a valve and open an escape-port communicating with each such reservoir, substantially as set forth.

In testimony whereof I have hereunto set my hand.

GEORGE WESTINGHOUSE, JR.

Witnesses:

R. H. WHITTLESEY.

GEORGE H. CHRISTY.

GEORGE WESTINGHOUSE, JR., of Pittsburg, Pennsylvania.

Air-brake Apparatus.

Specification forming part of Letters Patent No. 243,415, dated June 28, 1881. Application filed April 1, 1881. (No model.)

To all whom it may concern :

Be it known that I, George Westinghouse, Jr., of Pittsburg, county of Allegheny, State of Pennsylvania, have invented or discovered a new and useful improvement in air-brake apparatus; and I do hereby declare the following to be a full, clear, concise, and exact description thereof, reference being had to the accompanying drawings, making a part of this specification, in which—like letters indicating like parts—

(Here follow diagrams marked pp. 1258 & 1260.)

Figure 1, sheet 1, is a longitudinal sectional view of the "triple" or automatic valve employed in my present improvement, with its ports and connections, and also showing, in part, an auxiliary reservoir and valve-chamber. Fig. 2 is a transverse sectional view in the plane of the line *xx* of Fig. 1, looking to the left, and showing the cock, plug, or key K in elevation. Fig. 3 is a side elevation of the triple-valve case as looked at from the left of Fig. 2; and Fig. 4, sheet 2, is a diagram view illustrative of the organization of a brake apparatus embodying the present improvements.

My present invention is more particularly directed to the construction and combination of apparatus whereby the two styles or systems of air-brake apparatus commonly known as the "Westinghouse compressed-air brake" and the "Westinghouse automatic brake" may be combined in use and operation at the same time on the same train.

While I do not limit myself to any particular train use of this combination, I have devised it with particular reference to train purposes, especially on roads which have long and heavy grades, and where a moderate but comparatively constant degree or amount of brake-power has to be applied for a considerable time; and I also provide an improved means for releasing and cutting off or out of action the automatic part of the apparatus in case, for any reason, it should get out of order when out on the line where repairs can not be made.

Some of the features of construction of the present apparatus are shown in patent No. 235,922, granted to me December 28, 1880. Here, as there, the brake-cylinder, the auxiliary reservoir, and the valve-case which contains the valve apparatus employed for giving proper direction to the flow of the fluid-pressure in the automatic brake, are, by preference, included in what may be termed a "single

No. 40,3426.
Westinghouse Co } p. 1258.
Piquito.

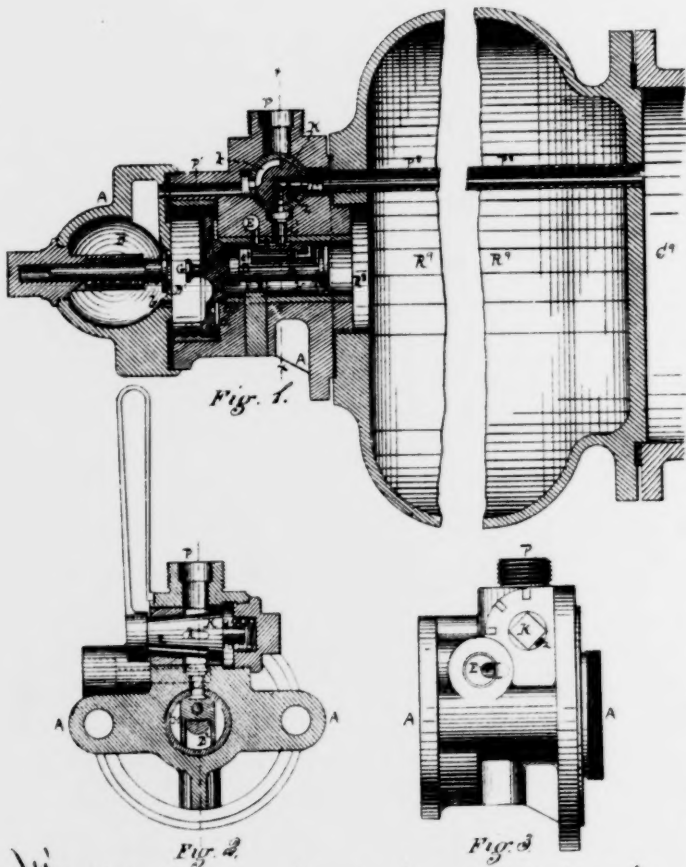
(No Model.)

2 Sheets—Sheet 1.

G. WESTINGHOUSE, Jr.
 Air Brake Apparatus.

No. 243,415.

Patented June 28, 1881.



Witnessed
R. H. H. H. H. H.
E. L. H. H. H.

Inventor George Westinghouse Jr.
By Attorney George A. Christy

*Nos. 403 & 426 }
 Westinghouse Co } p 1260
 Bayden Co }*

(No Model.)

2 Sheets—Sheet 2.

G. WESTINGHOUSE, Jr.
 Air Brake Apparatus.

No. 243,415.

Patented June 28, 1881.

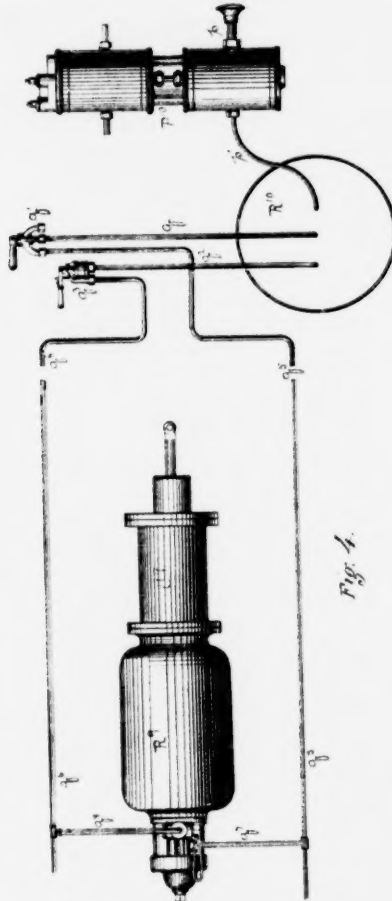
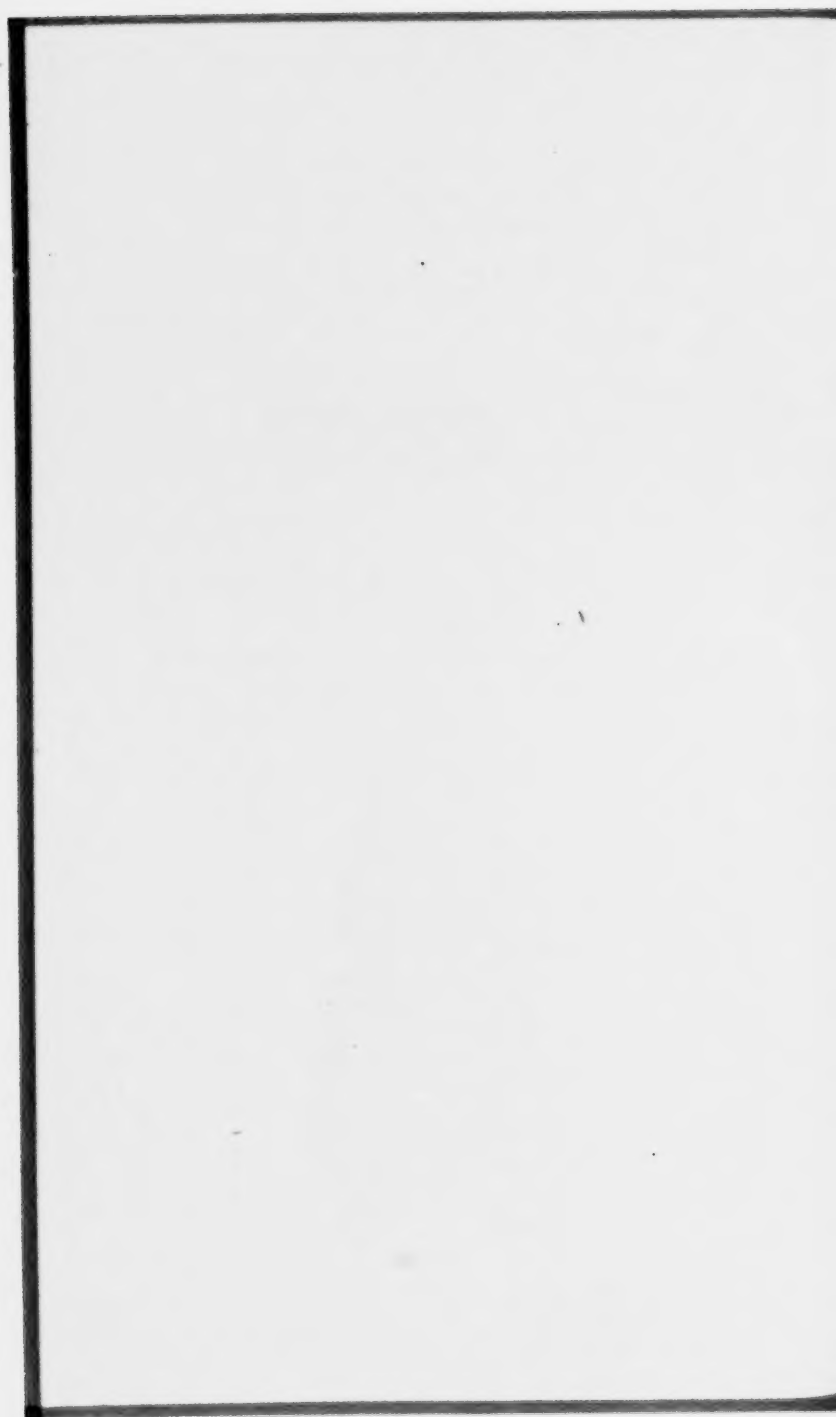


Fig. 4.

*Witnessed
 R. H. Westinghouse
 C. L. Parker*

*Inventor George Westinghouse
 By Attorney George H. Christy*



structure," one of such structures being applied to each car as a part of the automatic appliances.

In the diagram, Fig. 4, I have shown in outline, but with sufficient clearness for the present purpose, an air-compressing pump, P^{10} , a main reservoir, R^{10} , the air inlet-pipe p , which supplies air to the pumping-cylinder, and the air-pipe p' , which leads to the main reservoir. From this main reservoir, usually arranged on the locomotive, two lines of brake-pipe extend back beneath the cars of the train. The one line, q , leads, by the ordinary three-way cock q' , to the brake-pipe q^5 , which pipe and cock may represent such as are used with the "Westinghouse compressed-air brake," so called, wherein the power is first stored up in the reservoir, and then by manipulation of the cock is allowed to flow back through the brake-pipes when, and only when, it is desired to apply the brakes. In the other line a pipe, q^2 , leads to a cock, q^3 , such as is used or is adapted for use in working the Westinghouse automatic brake, and from this the brake-pipe q^6 leads back beneath the cars, as before. This line may be called the "automatic line." The usual hose and couplings are to be added between cars, and in other respects (not herein specified) these appliances are to be fitted up in any of the ways known in the art.

The apparatus through which both lines of pipe, q^5 and q^6 , are brought into conjoint use is illustrated in all the figures, but more fully in Fig. 1, where R^9 represents the auxiliary reservoir, and C^9 the brake-cylinder, a portion of each being broken away for convenience of illustration. The outer end of the reservoir R^9 has a large open port, R^8 , and over this port is secured, by bolting or otherwise, the valve-case A of what is termed in the Westinghouse automatic brake a "triple valve." This triple-valve device has substantially the construction described in United States patent No. 220,556, granted to me October 14, 1879, with more particular reference to Fig. 4 thereof, with the exception that the port there marked C , and here marked $C C'$, leads by pipe P^8 directly through the auxiliary reservoir R^9 to the brake-cylinder, here marked C^9 , though obviously it may pass around outside the auxiliary reservoir,

1262 if so preferred; also, the escape-port there, as here, lettered E , instead of opening into the open air, opens into a branch, q^7 , Fig. 4, of the line of brake-pipe q^5 ; also, the cock K , in addition to the ports $k k'$, has an additional port, z , which opens to the external atmosphere, Figs. 2 and 3.

The construction and operation of devices not herein specifically described will be readily understood by reference to the patent last named, where similar devices have like lettering; but even this reference is unnecessary, as the devices in question are already in extensive public use, and, as such, constitute a part of the art already known to those skilled therein.

With the appliances in their usual or normal condition—that is, with the pipe q^5 free of more than atmospheric pressure, the cock q' closed, the cock q^3 open, so that the pipe q^6 , with its branch q^7 , and the auxiliary reservoirs R^9 charged with a working fluid-pressure, and the triple valve in the position shown in Fig. 1, the train will

be in running order and the brakes will be off. Each auxiliary reservoir will receive its charge of compressed air from q^8 by the appropriate ports and passages P, k, P', B, b, B', a a' a², B² and R². If, now, the engineer wishes to apply the brakes, he shifts his automatic cock q^3 in the usual way, which will result in the lowering of the pressure in the brake-pipe q^6 and chamber B', cause a back-stroke of the piston G, which will shift the valve H, cut off the port E, and open communication from R², through C, k', and C' and P² to the brake-cylinder C², so as to apply the brakes with more or less force, according to the amount of the reduction of air-pressure in the pipe q^6 .

Thus far the operation varies in no material respect from what is described in the patents above referred to; but it is of great importance in the running of heavy trains down very long and steep gradients that a uniform and easily regulated variable pressure be maintained in the brake-pipes and cylinders, which is sometimes somewhat difficult with the automatic apparatus alone.

By my present invention, instead of exhausting into the open air the fluid-pressure as it escapes from the brake-cylinder when the brakes are partially or wholly released by the "automatic" method of operation, I connect the escape-port E, by the branch q^7 , with the pipe q^5 , so that the escaping air shall go into and be confined in such pipe. Then, as the brakes are successively applied and released in the automatic operation, the fluid-pressure escaping from the brake-cylinder on each release will be charged into the brake-pipe q^5 , and will soon accumulate to, or nearly to, the degree of pressure which the engineer may desire to preserve in his brake-cylinder, and the pipe q^5 and the brake-cylinder being brought into communication on each release, the same degree of pressure, or nearly the same, will soon exist in both. In case such degree of pressure should accidentally or by miscalculation, or in consequence of a change in the speed of the train, or on account of a change of grade, or for other cause, become too great, such operative pressure may be reduced much or little by shifting the cock q' so as to lower the pressure in q^5 , and, of course, in the brake-cylinder.

Should operative pressure at any time, for any reason, be too little, it may be increased by working the automatic, as before, or by shifting the cock q' so as to turn on pressure from the main reservoir through the pipe q^5 . In this way, through two separate lines of connection, each of which may be brought into action independently of the other, the engineer possesses the most perfect control over his brakes, and through them over his train, on all variations of track, grade, or speed; and it is also a further advantage that while the automatic acts the more quickly, it is possible, by combining the two systems of operation, particularly with engineers unskilled in the accurate use of the automatic, to get more accurate adjustments of brake-power by using the compressed-air system by pipe q^5 , for effecting slight variations of pressure after the average or approximately the desired pressure has been attained with the automatic. Also, it has sometimes happened in unskilled hands or in consequence of injury or imperfect care, that the automatic

brake would not release on the restoration of the pressure in pipe g^6 . When this happens the cock K may be turned so as to bring the port z into communication with the port C', and thereby let the air escape from the brake-cylinder C⁹, and so release the brakes. To this end the port z is made lengthwise of the cock, key, or plug, and at its outer end opens to the atmosphere.

I have described the invention as applied to a single set of car equipment; but the apparatus described is merely duplicated on the different cars of the train. It should be stated, however, that the hose-couplings between the cars on the pipe g^5 , by preference, have no valves to close their ports when a train pulls in two, and the rear coupling of the last car should be closed by a dummy, special cock, or otherwise.

I claim herein as my invention—

1. The method of combining a compressed-air system of brake apparatus and an automatic system by connecting the brake-pipe of the former with the exhaust-port of the latter, substantially as set forth.

2. A cock, K, having an exhaust-port, z, in combination with the brake-cylinder and exhaust-pipe of an automatic brake apparatus, substantially as set forth.

In testimony whereof I have hereunto set my hand.

GEORGE WESTINGHOUSE, Jr.

Witnesses:

R. H. WHITTLESEY.

C. S. PARKER.

1269

UNITED STATES PATENT OFFICE.

GEORGE A. BOYDEN, of Baltimore, Maryland, assignor of one-half to Charles B. Mann, of same place.

Fluid-pressure Brake.

Specification forming part of Letters Patent No. 280,285, dated June 26, 1883. Application filed April 30, 1883. (No model.)

To all whom it may concern :

Be it known that I, George A. Boyden, a citizen of the United States, residing at Baltimore, State of Maryland, have invented certain new and useful improvements in fluid-pressure brakes, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to certain improvements in fluid-pressure brakes for railway-trains, and to an improved method of applying and maintaining the application of the brakes.

The objects of the invention are, first, to provide for replenishing while the brake is on, the air-reservoir on each car or the brake-cylinder when the pressure therein has been lessened by leakage, and to accomplish this through a single line of train-pipe and by means which shall at all times be wholly under the control of the engineer, and also to provide for the more rapid charging than heretofore of the air-reservoir on the car, and also to obviate the necessity of applying the brakes with such a high pressure as heretofore has been necessary with the automatic brake, the effect of which is to slide the wheels and flatten them; second, to provide for dispensing with the main air-reservoir on or near the locomotive, and thereby simplify and cheapen the apparatus; third, to provide for the quicker release of the brake.

My invention consists, first, in the several combinations, herein-after specified, with an air-reservoir on the car, of means whereby the said air-reservoir may be replenished or recharged with compressed air while the passages or ports leading therefrom to the brake-cylinder are open and while the brakes are applied; second, in the combination, with an air-reservoir on the car and air-compressing apparatus on the locomotive, of means whereby is afforded the principal advantages of the "automatic" brake system, as well as the direct compressed-air system, without employing the usual main air-reservoir on or near the locomotive; third, in the combination, with an air-reservoir on the car, of a brake-releasing valve, whereby, when the train-pipe contains the maximum fluid-pressure, the brakes will be released quickly; fourth, in a new method of applying and maintaining the application of the brakes through a single line of train-pipe, as hereinafter specified.

(Here follow diagrams marked pp. 1264, 1266, & 1268.)

No. 4031426.
 Westinghouse Co. } p 1264
 Daydon Co.

(No Model.)

3 Sheets—Sheet 1.

G. A. BOYDEN.

FLUID PRESSURE BRAKE.

No. 280,285.

Patented June 26, 1883.

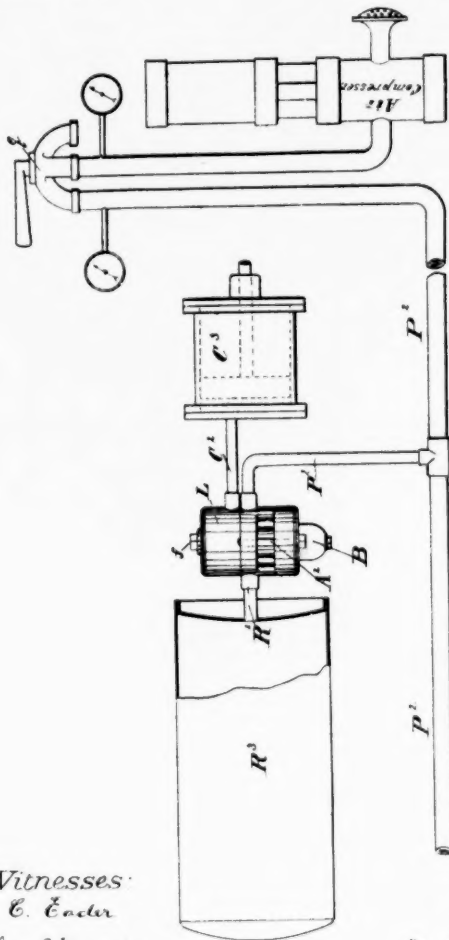
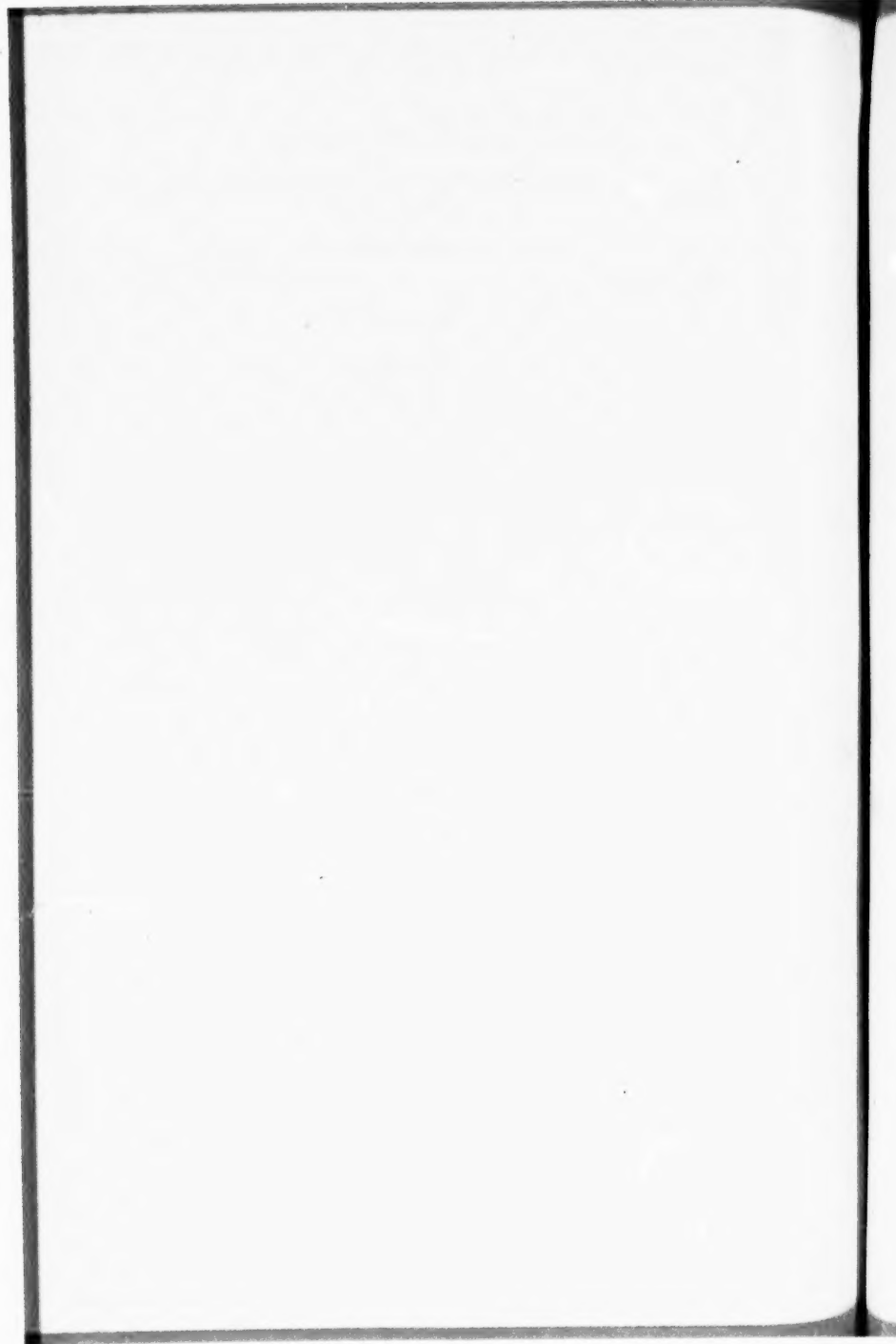


Fig. 1.

Witnesses:
 A. C. Ender
 John E. Morris

Inventor
 Geo. A. Boyden
 By Chas. B. Allen
 Attorney.



No. 403 r426.
Westinghouse Co. } p 1266.
Boyd Co.

(No Model.)

3 Sheets—Sheet 2

G. A. BOYDEN.

FLUID PRESSURE BRAKE.

No. 280.285.

Patented June 26, 1883.

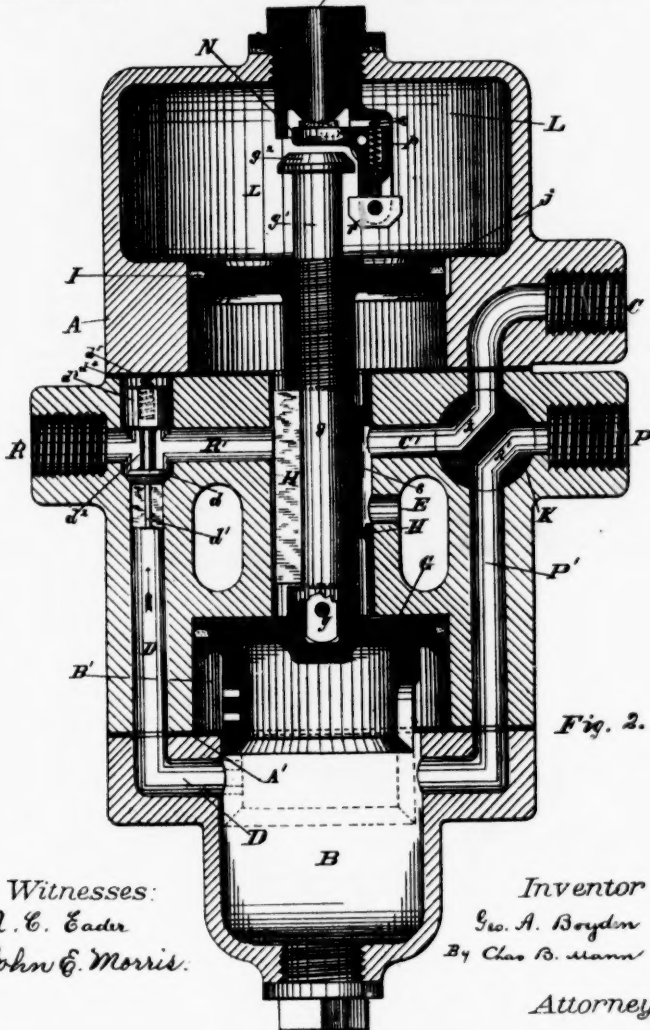


Fig. 2.

Witnesses:

A. C. Eader

John E. Morris.

Inventor

Geo. A. Boyden

By Chas B. Mann

Attorney.



No. 4034426
Westinghouse Co. } p 1268
Boyd Co.

(No Model.)

3 Sheets—Sheet 3.

G. A. BOYDEN.

FLUID PRESSURE BRAKE.

No. 280,285.

Patented June 26, 1883.

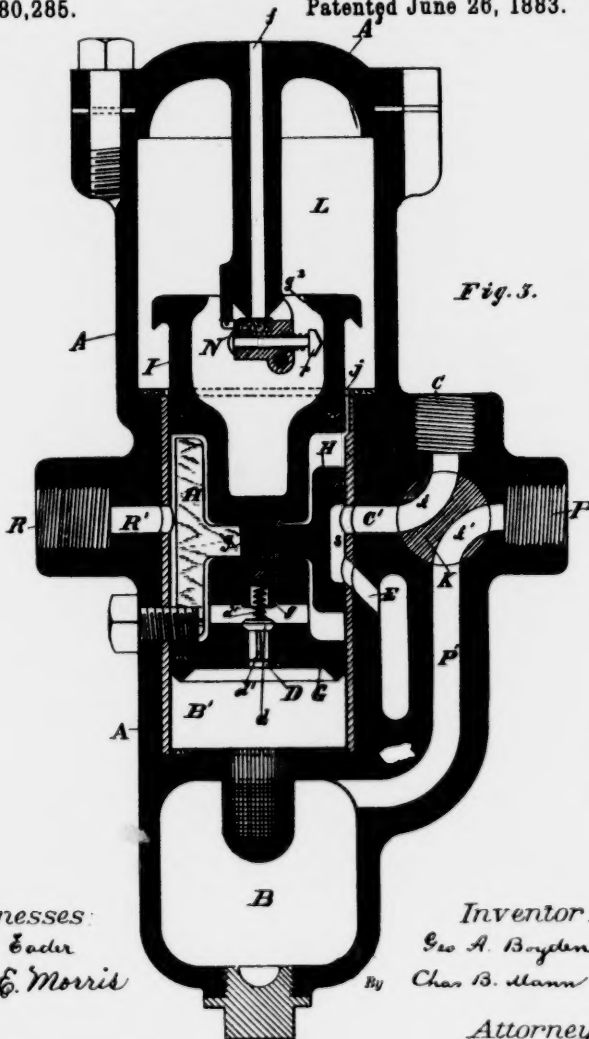


Fig. 3.

Witnesses:
A. C. Eader
John E. Morris

Inventor:
Geo A. Boyden
By Char B. Mann

Attorney.



Figure 1 is a view of the parts properly assembled of a brake apparatus embodying my invention. Fig. 2 is a sectional view, showing one plan of constructing the valve mechanism and air-cushion chamber. Fig. 3 is a sectional view, showing another plan of constructing the same parts.

The letter A designates the case of the valve; B, the drip-chamber attached at the bottom, (see Fig. 2,) and A' packing interposed between these parts, which are united by bolts A². (See Fig. 1.)

At the port P the train-pipe P² is attached. From this port a passage, P', leads to the drip-chamber B. Adjoining this chamber is a cylinder, B', fitted with a piston, G, which connects with a slide-valve, H, by means of a stem or rod, g. Instead of a slide-valve an ordinary three-way cock may be used. The slide-valve H has a cavity, s, long enough to uncover the passage C' and the exhaust-port E and put them in communication. The passage C' has outlet at port C, from which the pipe C² connects with the brake-cylinder C³.

At the port R is connected the pipe R², which leads to the air-reservoir R³ on the car. R' is a passage direct from this port to the valve-chamber.

A four-way cock, K, with ports k k', is arranged in line of the fluid-pressure communication, to provide for operating the brakes of the car by either the automatic system or the direct compressed-air system, according as the train of which the car forms part may happen to be fitted out.

The construction of the parts thus far described may vary or be changed in many ways without materially affecting the operation or result of my improvements, which I will now proceed to describe.

Extending from the drip-chamber is a passage, D, provided with a check-valve, d, adapted at all times to allow compressed air from the train-pipe P² to reach the air-reservoir on the car, but preventing its return therefrom, whereby no loss of fluid-pressure 1270 from reservoir R³ can occur in case of accidental separation of the car from the train, and serving also, as hereinafter explained, to allow compressed air from the train-pipe to reach the brake cylinder C³ while the brake is applied. As the fluid-pressure can take but one direction in this passage, I call it "an always-open one-way passage." A passage substantially like this, always open for fluid-pressure to reach the air-reservoir on the car, constitutes one feature of my invention.

The check-valve d may be constructed in any suitable manner. In the present case it has crossed wings d', which fit in the passage and adapt it to slide like a piston, so that the valve may leave its seat. In Fig. 2 a shank or rod, d², projects from the valve, and has attached a head, d³, which fits in a cylinder or bore, d⁴. A spiral-spring, d⁵, bears on the head in such manner as to keep the check-valve normally to its seat. At the other end of the piston stem or rod g, and connected thereto, is a second piston, I, fitting and arranged to move in a cylinder provided with a port, j, adapted to be closed when the piston is in one position and to be opened when the piston is in another. This port connects with an air-cushion

chamber, L. This air-cushion, or its equivalent, constitutes a feature of my invention. The air-cushion chamber L may be constructed without any opening, port, or valve whatever other than the one *j*, which is opened and closed by the piston I. This air-cushion chamber is employed to receive compressed air transmitted through the train-pipe at the maximum pressure. When the brakes are off, the piston I is in the position shown, and the fluid-pressure in the air-cushion chamber, which is on the outer side of the piston, is the same as the pressure on the inner side of the piston; but when the fluid-pressure in the train-pipe P^2 is reduced, such reduction of course is felt on the inner side of the piston, and thereupon the maximum pressure existing in the air-cushion chamber presses the piston I back, and through the stem *g* shifts the slide-valve H, closing the exhaust-port E and opening direct communication between the air-passage R' and the brake-cylinder passage C', thereby applying the brakes. It will thus be seen the first effect produced by the fluid-pressure in the air-cushion chamber is to shift the valve H, which applies the brakes. Heretofore in the Westinghouse brake the shifting of the valve has been effected wholly by the back action of the fluid-pressure in the auxiliary air-reservoir. Now, after a lessening of the fluid-pressure in the reservoir on the car or brake-cylinder, by leakage, has occurred, the maximum pressure in the chamber L has the further effect to act as an air-cushion to hold the valve H in the same position while the engineer manipulates the cock *g* on the locomotive to allow compressed air from the compressing apparatus to be transmitted through the always-open one-way-only passage D under a less pressure than the maximum, or less than that in the chamber L, to recharge and to continue charging the reservoir and brake-cylinder while the brakes are applied. This is a new and an important achievement through a single line of train-pipe, and enables me to dispense with the customary main air-reservoir on or near the locomotive, and constitutes a new method of maintaining the application of the brakes after they have been applied, and is a feature of my present invention. As long as the recharging is continued with the fluid under a less pressure than the maximum, or less than that in the chamber L, there will be no relaxation of the grip of the brake-shoes on the wheels.

Instead of a piston, I, for the fluid-pressure in the air-cushion chamber L to press against, a flexible or elastic diaphragm with suitable valves might be substituted. So far as concerns the air-cushion, of which the piston I is a part or necessary adjunct, I include as within my invention all known equivalents for the piston which will operate substantially as herein set forth.

It has been stated that the air-cushion chamber may be constructed without other opening, port, or valve than that which is opened and closed by the piston I; but in the present instance a valve, N, is provided in the said chamber, and its use effects the quick release of the brake, and the same constitutes another feature of my invention. This brake-releasing valve consists, as shown in Fig. 2, of the escape-port *f*, a right-angled lever, P, one arm of which

carries the valve N, which closes the escape-port, and the other arm of which carries a pivoted trigger, r . This arm is adapted to move laterally. When pressed down at one side, the trigger will yield, but when pressed upward on the same side it is unyielding. A spring, s , is arranged to keep the trigger normally in a given position. The piston-stem g has its upper end, g' , projecting past the piston I and into the air-cushion chamber. A head, g^2 , is on the projecting end.

From this description of the drawing it will now be understood that when on applying the brakes the piston I is pressed back by the maximum fluid-pressure in the chamber L the trigger r will yield as the head g^2 on the stem passes down, thereby allowing the head to pass. When the maximum fluid-pressure is transmitted from the compressing apparatus on the locomotive to release the brakes, the pistons and stems are forced up; but their upward movement now would ordinarily be tardy, because of the resistance of the air-cushion, and hence the brake now would be released slowly. This tardy release of the brake is a difficulty also sometimes experienced in the Westinghouse automatic brake on account of the resistance of the air in the auxiliary reservoir. To remedy this therefore, when the stem starts on its upward movement the head g^2 at

once comes in contact with the trigger r , which, not yielding, 1271 causes one arm P of the lever to move laterally, thereby removing the valve N from its seat over the escape-port and instantly allowing the fluid-pressure in the chamber to exhaust. There being then no longer any resistance, the brakes will be released instantly.

To charge the brake apparatus with fluid-pressure, compressed air from the compressing apparatus is transmitted through the train-pipe, and then direct through the always-open one-way passage to the air-reservoir. In charging as here described the circuitous and smaller passages or ports of the Westinghouse triple valve heretofore used are avoided. The fluid-pressure thus transmitted from the compressing apparatus, coming against the pistons G and I, forces them up, thereby closing the brake-cylinder passage C' and opening the port j , which allows the maximum fluid-pressure to enter the air-cushion chamber L. The same pressure at the outset will therefore exist on both sides of the piston I. Now, to apply the brakes, the engineer by slightly opening the cock q reduces the pressure in the train-pipe below the maximum stored in the air-cushion chamber, whereupon the effect is to press the pistons I G down, thus allowing the fluid-pressure in the reservoir R³ to pass through passages R' and C' into the brake-cylinder and apply the brakes. When through a lessening of the fluid-pressure by leakage it is desired to replenish or recharge the brake-cylinder without either releasing the brakes or relaxing the grip of the shoes on the wheels, the engineer may manipulate the cock q to transmit air under a less pressure than that stored up in the air-cushion chamber. By this method a constant supply of fluid-pressure is maintained in the air-reservoir on the car, and there is no longer need for a main air-reservoir on the locomotive, as heretofore.

In Fig. 3 the always-open one-way passage D and check-valve *d* is shown through the piston G instead of entirely at one side, as in Fig. 2. The case A, drip-chamber B, and air-cushion chamber L are here shown united in a single casting instead of being composed of three pieces, as in Fig. 2. A cap, A³, is bolted over and constitutes the top of the air-cushion chamber. As shown in this figure, the device can be more cheaply constructed.

As already explained, the form, and to some extent the arrangement of the valves, ports, and passages, may be varied or changed without materially affecting the operation of the parts herein combined, and I hereby include such modifications as within the scope of my invention. I also include herein as an equivalent for the air-cushion chamber any substitute—such as a spring—which may be compressed by the maximum fluid-pressure, and then, when such pressure is reduced to apply the brake, will, like the air-cushion, hold the valve H while the brake-cylinder is replenished or recharged. Any such equivalent or substitute as produces substantially a like operation or result I here include as of my invention.

While the several novel features—to wit, air-cushion chamber L, the release-valve N, and the always-open one-way-only passage D—are adapted and specially designed for use without reference to and independent of a main air-reservoir on the locomotive, and are so shown here, said features may nevertheless be used, with all their resulting advantages unimpaired, in connection with a main air-storage reservoir on the locomotive, as now employed by the Westinghouse system of automatic brakes. Therefore my claims herein-after given apply and cover said features in both said systems. In the event of the accidental separation of the cars of a train, the brakes will at once be applied as in the automatic brake-system.

By my improvements very important results are attained—to wit, a brake is provided which affords the principal advantages of the automatic system, as well as the principal advantages of the "direct" compressed-air system, without the disadvantages or difficulties heretofore experienced in either.

Having described my invention, I claim and desire to secure by letters patent of the United States—

1. In fluid-pressure brakes, the combination, with the train-pipe and an air-reservoir on the car, of a passage between the two always open one way only adapted at all times to allow fluid-pressure to enter the air-reservoir, substantially as set forth.

2. In fluid-pressure brakes, the combination, with a brake-cylinder, an air-reservoir on the car, and valve mechanism to open and close connection between the cylinder and reservoir, of means, substantially as described, whereby the brake-cylinder may be directly recharged with fluid-pressure from a single line of train-pipe while the brakes are applied, as set forth.

3. In fluid-pressure brakes, the combination, with a brake-cylinder, an air-reservoir on the car, and valve mechanism to open and close connection between these two, of an air-cushion chamber provided with means by which air compressed in the chamber will hold the

valve mechanism to maintain communication between the reservoir and cylinder, substantially as set forth.

4. In a fluid-pressure brake, the combination of a brake-cylinder, an air-reservoir on the car, valve mechanism to open and close connection between the cylinder and reservoir, means, substantially as described, to hold the valve mechanism, air compressing apparatus on the locomotive, and train-pipe to connect directly between the air-compressing apparatus and the said appliances on the car, whereby the usual main air-reservoir on or near the locomotive is dispensed with, as set forth.

5. In a fluid-pressure brake, the combination of a brake-cylinder, an air-reservoir on the car, valve mechanism to open and close connection between the cylinder and reservoir, means, substantially as described, to hold the valve mechanism and a passage
1272 always open one way only to allow fluid pressure from the train-pipe to enter the brake-cylinder while the brakes are applied, as set forth.

6. In fluid-pressure brakes, the combination, with the valve mechanism which opens and closes communication between the brake-cylinder and air-reservoir, of a brake-releasing valve adapted, when fluid-pressure is applied in the train-pipe, to release the pressure back of the valve mechanism, substantially as set forth.

7. In fluid-pressure brakes, the method of applying and maintaining the application of the brakes through a single line of train-pipe, consisting of first applying the brakes by the admission to the brake-cylinder of the fluid-pressure in the air-reservoir on the car, and then maintaining the application of the brakes by the admission to the brake-cylinder of fluid-pressure directly from the air-compressing apparatus on the locomotive, as set forth.

8. In fluid-pressure brakes, the method of applying and maintaining the application of the brakes through a single line of train-pipe, consisting of compressing air and transmitting the maximum pressure to the air-reservoir on the car, applying the brakes from the air-reservoir by reducing the pressure in the train-pipe, and then, when through a lessening of the pressure by leakage it is desired to recharge, transmitting through the train-pipe compressed air under a less pressure than the maximum, as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

GEO. A. BOYDEN.

Witnesses:

J. EDWARD MORRIS.

JNO. T. MADDOX.

1279

UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., of Pittsburg, Pennsylvania.

Fluid pressure Automatic-brake Mechanism.

Specification forming part of Letters Patent No. 360,970, dated March 29, 1887.

Application filed November 19, 1886. Serial No. 219,353. (Model.)

To all whom it may concern :

Be it known that I, George Westinghouse, Jr., residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, a citizen of the United States, have invented or discovered certain new and useful improvements in fluid-pressure automatic-brake mechanism, of which improvements the following is a specification.

The object of my invention is to enable the application of brake-shoes to car-wheels by fluid pressure to be effected with greater rapidity and effectiveness than heretofore, more particularly in trains of considerable length, as well as to economize compressed air in the operation of braking by utilizing in the brake-cylinders the greater portion of the volume of air which in former practice was directly discharged into the atmosphere.

To this end my invention, generally stated, consists in a novel combination of a brake-pipe, an auxiliary reservoir, a brake-cylinder, and a "triple-valve" device governing, primarily, communication between the auxiliary reservoir and the brake-cylinder, and, secondarily, communication directly from the brake-pipe to the brake-cylinder.

The improvements claimed are hereinafter fully set forth.

In the application of the Westinghouse automatic brake as heretofore and at present commonly in use, each car is provided with a main air-pipe, an auxiliary reservoir, a brake-cylinder, and a triple valve, the triple valve having three connections—to wit, one to the main air-brake pipe, one to the auxiliary reservoir, and one to the brake-cylinder. The main air-pipe has a stop-cock at or near each of its ends, to be opened or closed as required, and is fitted with flexible connections and couplings for connecting the pipes from car to car of a train, so as to form a continuous line for the transmission of compressed air from a main reservoir supplied by an air-pump on the engine. When the brakes are off or released, but in readiness for action upon the wheels of the train, the air which fills the main reservoir and main air-pipes has a pressure of from sixty-five to seventy-five pounds to the square inch, and by reason of the connections referred to the same pressure is exerted in the casings of the triple valves on both sides of their pistons and in the auxiliary reservoirs connected therewith. At the same time passages called "release-ports" are open from the brake-cylinders to the atmosphere. When it is desired to apply the brakes, air is allowed to escape from

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Westinghouse Co } *p 1274.*
Hyden Co

(Model.)

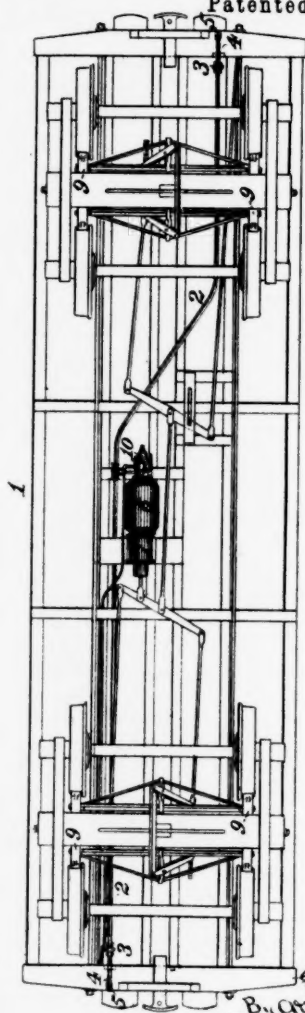
G. WESTINGHOUSE, Jr.

3 Sheets—Sheet 1.

FLUID PRESSURE AUTOMATIC BRAKE MECHANISM.

No. 360,070.

Patented Mar. 29, 1887.



Witnesses
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 By *Attorney* *J. Thurman Bell*

No. 403 r426.
 Westinghouse & Co. } p 1278
 Dryden Co.

(Model.)

3 Sheets—Sheet 3.

G. WESTINGHOUSE, Jr.

FLUID PRESSURE AUTOMATIC BRAKE MECHANISM.

No. 360,070.

Patented Mar. 29, 1887.

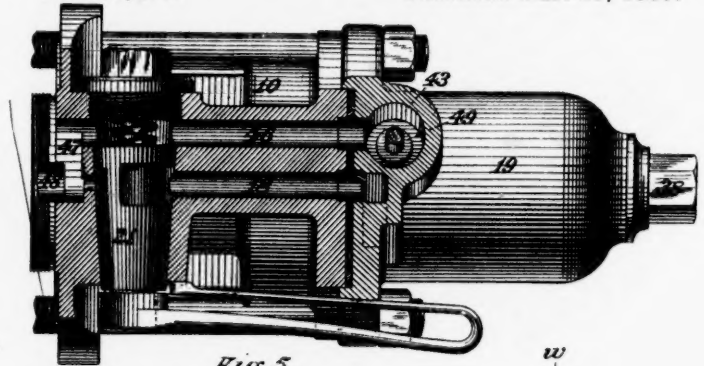


Fig. 5.

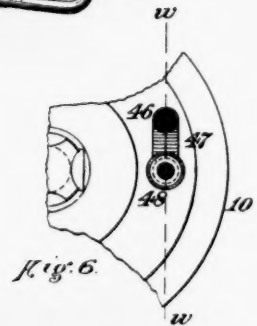


Fig. 6.

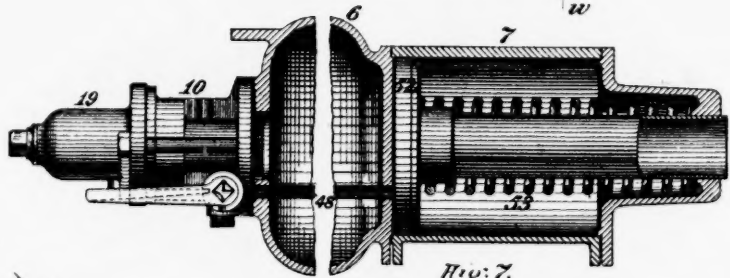


Fig. 7.

Witnesses
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 By Attorney J. Mendenhall

the main air-pipes through the engineer's valve, thereby reducing the pressure in the main air-pipes, whereupon the then higher pressure in the auxiliary reservoirs moves the pistons of the triple valves, so as to first close the passages from the triple valves to the brake-pipe and at the same time close the release-ports of all the brake-cylinders, and then open the passages from the auxiliary reservoirs to the brake-cylinders, the pistons of which are forced out by the compressed air thereby admitted to the brake-cylinders, applying the brakes by means of suitable levers and connections, all of which mechanism is fully shown in various letters patent granted to me.

The application of the brakes with their full force has heretofore required a discharge of air from the main pipe sufficient to reduce the pressure in said pipe below that remaining in the auxiliary reservoir after the brakes have been fully applied, and it has been found that, while the brakes are sufficiently quick in action on comparatively short trains, their action on long trains of from thirty to fifty cars, which are common in freight service under present practice, is in a measure slow, particularly by reason of the fact that all the air required to be discharged from the main pipe to set the brakes must travel from the rear of the train to a single discharge-opening on the engine. This discharge of air at the engine has not only involved a serious loss of time in braking, but also a waste of air. Under my present invention a quicker and more efficient action of the brakes is obtained, and air which has been heretofore wasted in the application of the brakes is almost wholly utilized to act upon the brake-pistons.

In the accompanying drawings—

(Here follow diagrams marked pp. 1274, 1276, & 1278.)

Figure 1 is an inverted plan view of a railroad-car, illustrating the application of my invention; Fig. 2, a longitudinal section, on an enlarged scale, through the triple valve at the line *xx* of Fig. 4; Fig. 3, a transverse section through the same at the line *yy* of Fig.

2; Fig. 4, a bottom plan view of the cap or drain-cup of the triple valve; Fig. 5, a longitudinal section through the triple valve at the lines *zz* of Fig. 3 and *ww* of Fig. 6; Fig. 6, a partial bottom plan view of the triple valve; and Fig. 7, a longitudinal central section through the brake-cylinder and auxiliary reservoir, with the triple valve in elevation.

In the practice of my invention each railroad car 1 on which it is applied is, as heretofore, provided with a main air-pipe, 2, governed by stop-cocks 3, adjacent to its ends, and having a flexible connection, 4, and coupling 5 at each end, to admit of being coupled to the main air-pipe of the tender or the adjacent car or cars of a train. An auxiliary reservoir, 6, and brake-cylinder 7 are secured in convenient position below the sills of the car, the brake-cylinder having a piston, 52, by the movement of which, through a system of lever-connections, which do not form part of my present invention, the brake-shoes 9 are applied to and released from the wheels of the car, compressed air being supplied to and released from the brake-

cylinder 7 as the pressure in the main air-pipe is reduced or reinstated, respectively, by means of a triple valve, 10, the casing or chest of which communicates with the main air-pipe, the auxiliary reservoir, and the brake-cylinder.

So far as the performance of its preliminary function in ordinary braking is concerned—that is to say, effecting the closure of communication between the main air-pipe and the auxiliary reservoir, and the opening of communication between the auxiliary reservoir and the brake-cylinder in applying the brakes, and the reverse operations in releasing the brakes—the triple valve 10 accords substantially with that set forth in letters patent of the United States No. 220,556, granted and issued to me October 14, 1879, and is not, therefore, saving as to the structural features by which it performs the further function of effecting the direct admission of air from the main air-pipe to the brake-cylinder, as presently to be described, claimed as of my present invention. Certain of its elements devised and employed by me prior thereto will, however, be herein specified, in order to render its construction and operative relation to other members of the brake mechanism fully intelligible.

The case or chest in which the operative mechanism of the triple valve proper, 10, is mounted is fixed under or on the car-body in any convenient position relatively to the auxiliary reservoir 6 and brake-cylinder 7, being in this instance shown as secured directly to one end of the auxiliary reservoir, in line axially therewith and with the brake-cylinder, which is secured to its opposite end. The triple-valve case is fitted at one end with a cylindrical sleeve or bushing, 11, which is bored out truly and forms the chamber of a piston, 12, which is fixed upon a stem, 13, carrying, as in my letters patent No. 220,556, before mentioned, a slide-valve, 14, which controls communication between the auxiliary reservoir and the brake-cylinder, and between the brake-cylinder and release-port 15, respectively. The auxiliary reservoir 6 is continuously in communication with the chamber 11, on one side of the piston 12, through the longitudinal chamber 24 of the case in which the slide-valve 14 moves, and the triple-valve case communicates, by a passage, 16, with the brake-cylinder, and, by a passage, 17, with the main air-pipe 2. The passage 17, leading from the main air-pipe, communicates, by a passage, 18, with the cap or, as it is ordinarily termed, the "drain-cup" 19 of the triple valve, from which passages 20 lead into the piston-chamber 11. A four-way cock, 21, controls the passages 16, 17, 18, and a passage, 22, leading to a port, 23, in the face or seat of the slide-valve 14. When in the position shown in the drawings, communication is continuously maintained between the main air-pipe 2 and piston-chamber 11, through the passages 17 and 18, drain-cup 19, and passages 20, and by turning the cock 21, so as to establish communication between the passages 16 and 17, the triple valve and auxiliary reservoir will be cut out from the main air-pipe, and the mechanism can be operated as a non-automatic brake, the admission of air under pressure to the main air-pipe and brake-cylinder effecting, in such case, the application of the brakes.

The entire brake mechanism of the car other than the main air-pipe may be put out of action, when for any reason required, by turning the cock 21 into position to cover the passages 16 and 18, the main air-pipe then serving only for the transmission of air between the portions of the train-line made up by the main air-pipes of the remaining vehicles.

The slide-valve 14 is loosely connected with the stem 13 of the piston 12, and by a pin, 25, extending across the stem and fixed in the side plates of the valve, is prevented from being separated from the stem when removed for examination. It is held up to its seat in the chamber 24 by a spring, 26. The valve partakes in the reciprocating movements of the stem 13, being moved in one or the other direction by a collar, 27, and a shoulder, 28, respectively, on the stem. Said collar and shoulder are located at a distance apart slightly greater than the length of the valve 14, so that a limited degree of traverse of the stem 13 and piston 12 in each direction is effected without imparting movement to the valve. A graduating-valve, 29, secured upon a stem, 30, which is moved by the piston-stem, 13, governs a passage, 31, in the slide-valve 14, said passage communicating by a lateral port, 32, with the valve-chamber 24, and consequently with the auxiliary reservoir. A cavity or passage, 33, is formed on the face of the slide-valve 14, of such length as to establish communication during a portion of the traverse of 1281 the valve between the port 23 of the valve-chamber 24, which is open to the passage 16, leading to the brake-cylinder, and a port, 34, communicating with the relief-port 15.

The construction and relative arrangement of the piston-stem 13, slide-valve 14, and graduating-valve 29 are substantially similar to those of the corresponding parts as heretofore employed by me and exemplified in my letters patent No. 220,556; but under my present invention these are supplemented by a port, 35, leading from the end of the valve adjacent to the opening of the chamber 24, which communicates with the auxiliary reservoir, to the face of the valve, so as, at the limit of traverse of the piston-stem in the application of the brakes, to establish communication directly through said passage between the auxiliary reservoir and the port 23 and passages 22 and 16, leading to the brake-cylinder.

The piston-stem 13 abuts when the stem 13 and piston 12 are moved for the major portion of their traverse toward the drain-cup 19 against a stem, 36, which is fitted to slide freely in line axially with the stem 13 in an open-ended bushing, 37, in the end of the drain-cup 19 adjoining the piston-chamber 11, and in a guide formed in a screw-cap, 38, closing the opposite end of the drain-cup. A spring, 39, surrounding the stem 36 and bearing against the inside of the cap 38 and against a collar, 40, on the stem 36, maintains the latter in the position shown in Fig. 2, except when a sufficient pressure of air is admitted from the auxiliary reservoir to the piston-chamber to overcome the resistance of the spring and effect movement of the piston 12 beyond the point at which its stem 13 comes in contact with the stem 36.

So far as hereinbefore described, the triple valve accords in all

substantial particulars with and is adapted to operate similarly to those of my letters patent Nos. 168,359, 172,064, and 220,556, and, in order that it may perform the further functions requisite in the practice of my present invention, it is provided with certain additional members, which will now be described. For the purpose of effecting the admission of air directly from the main air-pipe 2 to the brake-cylinder 7 when it is desired to apply the brakes with great rapidity and full force, an auxiliary slide-valve, 41, is connected to and moves with the stem 36, said valve working over a face in the bushing 37 between the piston-chamber 11 and drain-cup 19, and governing a port, 42, in said face leading into a chamber, 43, adjoining the same. The valve 41 has lateral wings or plates fitting on each side of the stem 36, between shoulders or collars thereon, and is held thereto, when the stem is removed, between collars or shoulders thereon abutting against its ends, by a pin, 44, in its wings, a spring, 45, acting to hold it to its seat in the bushing 37 when in position. The chamber 43 communicates by a passage, 46, Fig. 5, with a chamber, 47, in the end of the case of the triple valve adjacent to the auxiliary reservoir, from which chamber a passage, 48, leads through the auxiliary reservoir into the brake-cylinder 7. The chamber 43 is further provided with a check-valve, 49, which opens outwardly into and controls the passage of air into the passage 46, said valve being held to its seat by a light spring, 50, and serving to prevent the return of air from the brake-cylinder when the pressure in the main air-pipe is reduced below that in the brake-cylinder, as in the case of the separation of the cars of the train by the breaking of a coupling.

In the operation of the brake mechanism as above described, air from the main reservoir and main air-pipe passes through the passages 17 18, drain-cup 19, and passages 20 into the piston-chamber 11, forcing the piston 12 to the left-hand extremity of its stroke and uncovering a small feeding-groove, 51, in the piston-chamber, through which air passes into the auxiliary reservoir 6 until the pressure in the latter is equal to that in the main air-pipe, the brake-cylinder being meanwhile in communication with the atmosphere through the passages 16 and 22, valve-cavity 33, and ports 23 34, and release-port 15. To apply the brakes in making ordinary stops, a portion of the air is discharged from the main air-pipe by the engineer's valve, thereby correspondingly reducing the pressure in the main air-pipe, whereupon the higher pressure in the auxiliary reservoir moves the piston 12 to the right, covering the feeding-groove 51, and thus preventing the return of air from the auxiliary reservoir to the main air-pipe, the movement of the piston continuing until arrested by the decrease of pressure in the auxiliary reservoir or by the stem 36 and its spring 39. The movement of the slide-valve 14 then closes the port 23, preventing escape of air from the brake-cylinder, and places the passage 31 partly or wholly in communication with the port 33. The small auxiliary valve 29 having been meanwhile unseated by the movement of the piston-stem, compressed air from the auxiliary reservoir passes through the lateral port 32 and passage 31 of the slide-valve 14 and the

passages 22 and 16 of the triple-valve case to the brake-cylinder, forcing out the piston, and, through an appropriate system of levers and connections, applying the brakes. When the pressure in the auxiliary reservoir has in this operation been reduced by expansion into the brake-cylinder until it is slightly below the pressure in the main air-pipe, the pressure on the air-pipe side of the piston 12 forces the piston 12 in the opposite direction until the auxiliary valve 29 closes the passage 31, thereby arresting the further flow of air from the reservoir to the brake-cylinder and holding the brakes with a force proportionate to the reduction of pressure in the brake-pipe. To release the brakes, the pressure in the main air-pipe is increased by admitting air from the main reservoir, whereupon the resultant increase of pressure in the piston-chamber

11 forces the piston 12 back to its original or normal position, 1282 permitting the escape of air from the brake-cylinder 7, the piston 52 of which is returned to its position by a spring, 53, releasing in its backward movement the brake-shoes 9 from the wheels, and at the same time the auxiliary reservoir is recharged. The admission of air to the brake-cylinder through the passage 31, which is opened just before the piston-stem comes in contact with the graduating-stem, and which corresponds to the feed-passage heretofore employed, suffices for the ordinary requirements of braking in regular service. In the event, however, of its becoming necessary to apply the brakes with great rapidity and with their greatest available force, the engineer, by means of the valve at his command, instantly discharges sufficient air from the front end of the main air-pipe to effect a sudden reduction of pressure of about twenty pounds per square inch therein, whereupon the piston 12 of the triple valve is forced to the extreme limit of its stroke in the direction of the drain-cup 19, carrying with it the stem 36 and auxiliary slide-valve 41, which instantly uncovers the port 42 and discharges air from the main air-pipe through the opening of the check-valve 49 and the passages 45 and 48 to the brake-cylinder, and, each car being provided with one of these devices, it will be seen that they are successively moved with great rapidity, there being practically on a train of fifty cars fifty openings for discharging compressed air from the main pipe, instead of the single opening heretofore commonly used. Not only is there a passage of considerable size opened from the brake-pipe on each car, whereby the pressure is more quickly reduced, but the air so discharged is utilized in the performance of preliminary work, it being found in practice that the air so taken from the pipe will exert a pressure of about twenty-five pounds in the brake-cylinders. When the piston 12 arrives at the extremity of its stroke, as above specified, the supplemental port 35 of the slide-valve 14 is brought into communication with the port 33 and passages 22 and 16, which serves to discharge the reservoir-pressure into the brake-cylinder, thereby augmenting the pressure already exerted in the brake-cylinder by the air admitted from the main air-pipe. Upon the reduction of the pressure in the main air-pipe below that in the brake-cylinders, as by the braking in two of the train, the check valve 49 closes communication between

the passages 46 and 18, thereby preventing the return of the air from the brake-cylinder to the main air-pipe. The feed-opening for the admission of air from the auxiliary reservoir to the brake-cylinder is purposely made of comparatively small diameter, it having been determined by experiment that the initial application of the brakes should not be made with maximum force, and this opening may be made of such size as to apply the brakes exactly in accord with the requirements of the most efficient work.

In using the terms "triple valve" and "triple-valve device" I refer to a valve device, however specifically constructed, having a connection with the main air or brake pipe, another with an auxiliary reservoir or chamber for the storage of power, and another with a brake-cylinder or its equivalent for the utilization of the stored power and with a release or discharge passage for releasing the operative power from the brake-cylinder, whether the valves governing these passages or connections are arranged in one or more cases and are moved by a piston or its equivalent or by a series of pistons or their equivalents, there being numerous examples in the art of constructions varying materially in appearance whereby these functions are performed, both in plenum and vacuum brake mechanisms.

While I have herein described my invention as applied in a brake mechanism utilizing air under pressure, such as is in general and approved use, I do not desire to limit myself to brakes so operated, as my improvements are likewise susceptible of application, without variation of principle, in connection with brakes worked by atmospheric pressure.

I am aware that a construction in which "an always-open one-way passage" from the main air-pipe to the brake-cylinder is uncovered by the piston of the triple valve simultaneously with the opening of the passage from the auxiliary reservoir to the brake-cylinder has been heretofore proposed, and such construction, which involves an operation different from that of my invention, I therefore hereby disclaim.

I claim as my invention and desire to secure by letters patent—

1. In a brake mechanism, the combination of a main air-pipe, an auxiliary reservoir, a brake-cylinder, a triple valve, and an auxiliary-valve device, actuated by the piston of the triple valve and independent of the main valve thereof, for admitting air in the application of the brake directly from the main air-pipe to the brake-cylinder, substantially as set forth.

2. In a brake mechanism, the combination of a main air-pipe, an auxiliary reservoir, a brake-cylinder, and a triple valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake-cylinder, and which by a further traverse admits air directly from the main air-pipe to the brake-cylinder, substantially as set forth.

3. In a brake mechanism, the combination of a main air-pipe, an auxiliary reservoir, a brake-cylinder, and a triple valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake-cylinder, and which by a further traverse admits air directly from the main air-pipe to the brake-cylinder and

effects a second admission of air from the auxiliary reservoir to the brake-cylinder, substantially as set forth.

4. The combination, in a triple-valve device, of a case 1283 & 1284 or chest, a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston-stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere, respectively, and an auxiliary valve actuated by the piston-stem and controlling communication between passages leading to connections with a main air-pipe and with the brake-cylinder, respectively, substantially as set forth.

5. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston-stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere, respectively, an auxiliary valve, actuated by the piston-stem and controlling communication between passages leading to connections with a main air-pipe and with the brake-cylinder, respectively, and a check or non-return valve interposed between the auxiliary valve and the passage leading therefrom to the brake-cylinder, substantially as set forth.

6. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston-stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere, respectively, an auxiliary stem mounted in the cap of the case in position to be moved longitudinally by the piston-stem in the latter portion of its traverse in the direction required for the application of the brakes, a spring bearing against a collar on the auxiliary stem and against a fixed abutment, and an auxiliary valve connected to the auxiliary stem and controlling communication between passages leading to connections with a main air-pipe and with the brake-cylinder, respectively, substantially as set forth.

7. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, an auxiliary valve actuated by the piston-stem and controlling communication between passages leading to connections with a main air-pipe and with a brake-cylinder, respectively, and a main valve connected to the piston-stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere, respectively, said main valve having a supplemental port or passage which establishes communication between the auxiliary reservoir and brake-cylinder connections at or near the limit of the traverse of the main valve in effecting the application of the brake under maximum pressure, substantially as set forth.

In testimony whereof I have hereunto set my hand.

GEO. WESTINGHOUSE, JR.

Witnesses:

J. SNOWDEN BELL.

R. H. WHITTLESEY.

1293

UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, JR., of Pittsburg, Pennsylvania.

Fluid-pressure Automatic Brake Mechanism.

Specification forming part of Letters Patent No. 376,837, dated January 24, 1888. Application filed October 1, 1887. Serial No. 251,195. (No model.)

To all whom it may concern :

Be it known that I, George Westinghouse, Jr., residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, a citizen of the United States, have invented or discovered certain new and useful improvements in fluid-pressure automatic brake mechanisms, of which improvements the following is a specification.

My present invention relates to appliances of the class exemplified in letters patent of the United States No. 360,970, granted and issued to me under date of March 29, 1887, and its object is to facilitate the application of brakes with great rapidity and full or approximately full force, as from time to time required, by the provision of means whereby the admission of air from the brake-pipe to the brake-cylinders may be effected as directly as practicable and through passages of as large capacity as may be desired.

The improvements claimed are hereinafter fully set forth.

In the accompanying drawings,

(Here follow diagrams marked pp. 1286, 1288, 1290, 1292)

Figure 1 is an inverted plan-view of a portion of a railroad-car, illustrating the application of my invention; Fig. 2, a longitudinal section, on an enlarged scale, through a valve mechanism embodying my invention at the line *ww* of Fig. 3; Fig. 3, a transverse section through the same at the line *xx* of Fig. 2; Fig. 4, a top view of the main slide-valve; Figs. 5 and 6, transverse sections through the same at the lines *yy* and *zz*, respectively, of Fig. 4; Fig. 7, a longitudinal section through the main slide-valve bushing, taken parallel to the valve-face thereof; Fig. 8, a longitudinal section through a valve mechanism, illustrating a modification of my invention at the line *vv* of Fig. 9; Fig. 9, a transverse section through the same at the line *uu* of Fig. 8; Fig. 10, a similar section through the supplemental valve casing at the line *tt* of Fig. 8; Fig. 11, a view in elevation of the supplemental valve seat; and Fig. 12 a longitudinal central section through a valve mechanism, illustrating a further modification of my invention.

As shown in Figs. 1 to 7, inclusive, my invention is applied in connection with a "triple-valve" device which in general structure and manner of operation, and saving as to the improvements hereinafter described, accords substantially with those set forth in my letters patent No. 220,556, dated October 14, 1879, and No. 360,970,

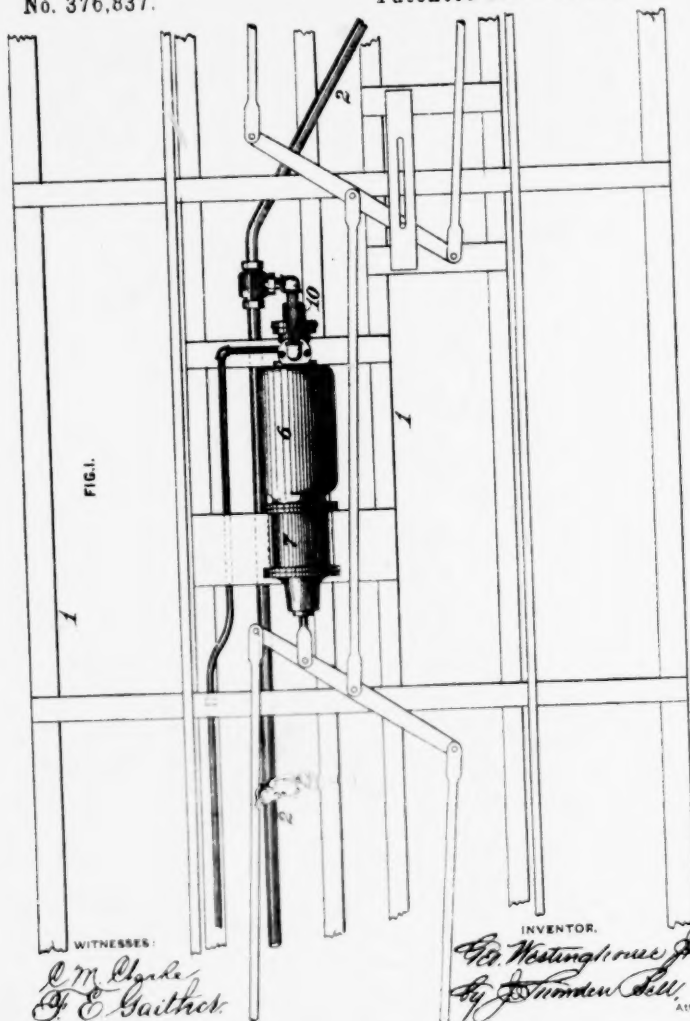
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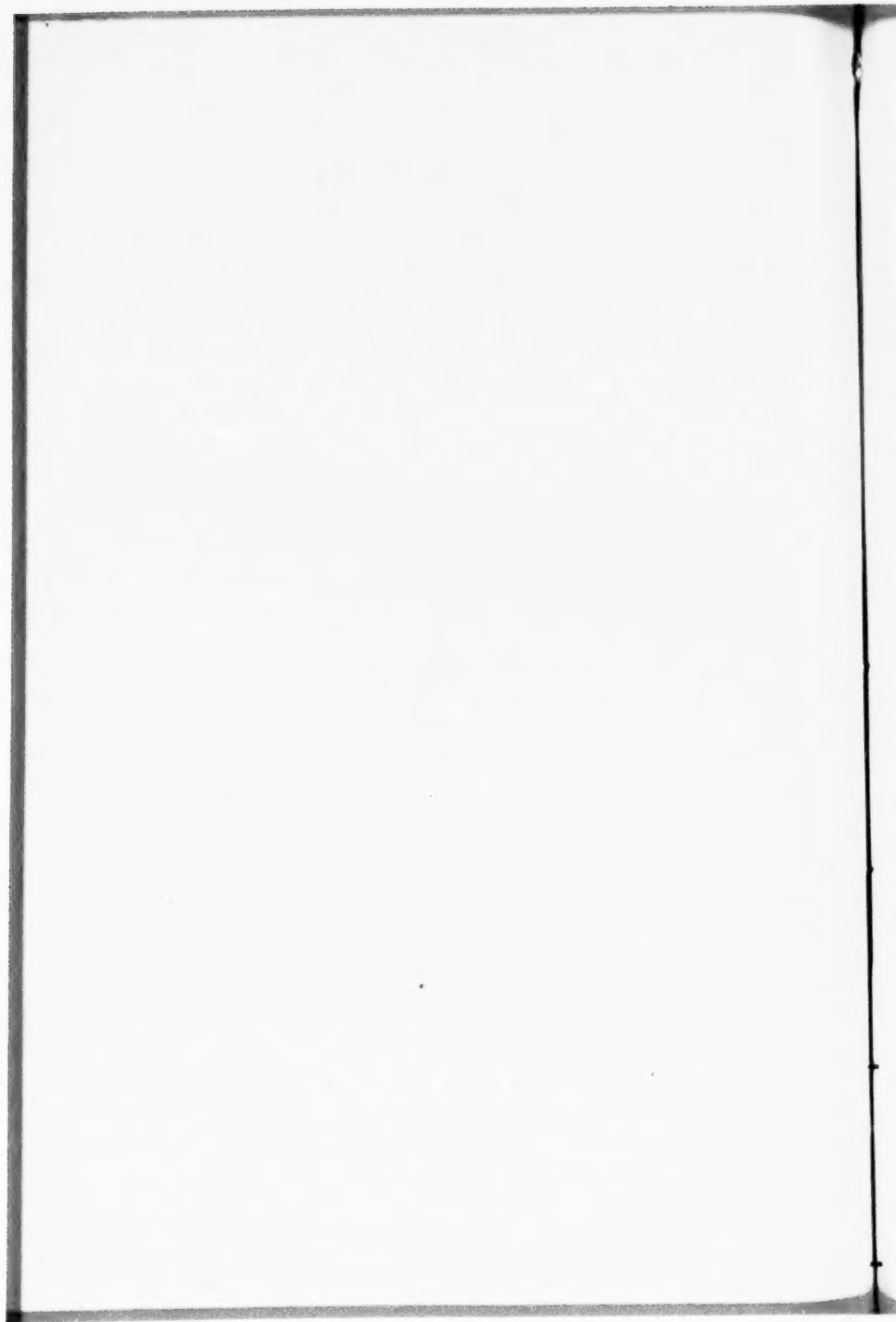
G. WESTINGHOUSE, JR.

G. WESTINGHOUSE, ST.
FLUID PRESSURE AUTOMATIC BRAKE MECHANISM.

No. 376,837.

Patented Jan. 24, 1888.





No. 403426.
Westinghouse & Co. p. 1288
Hydraulic

(No Model.)

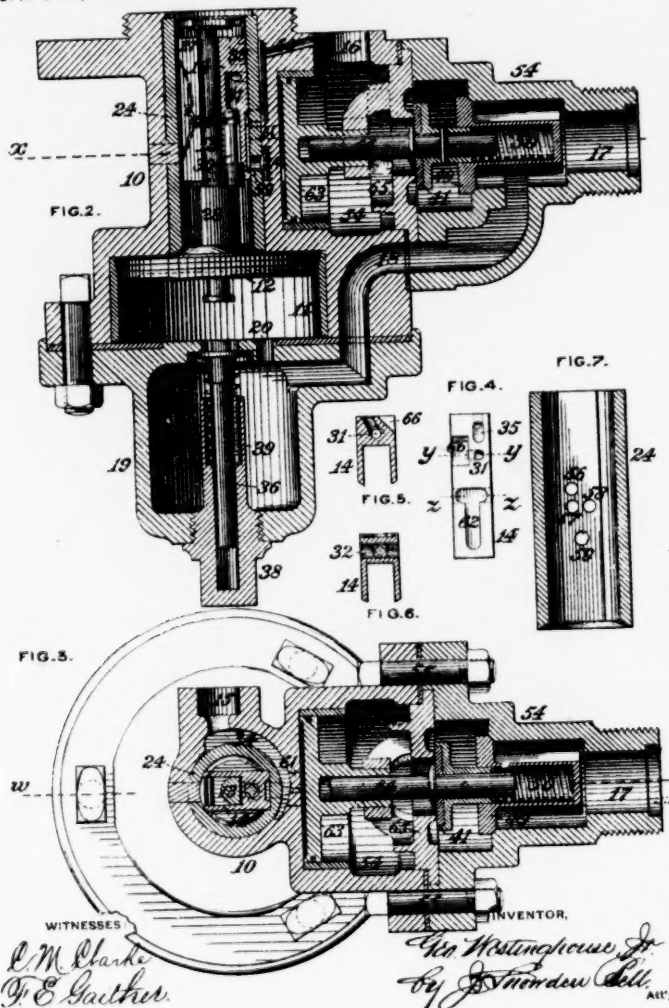
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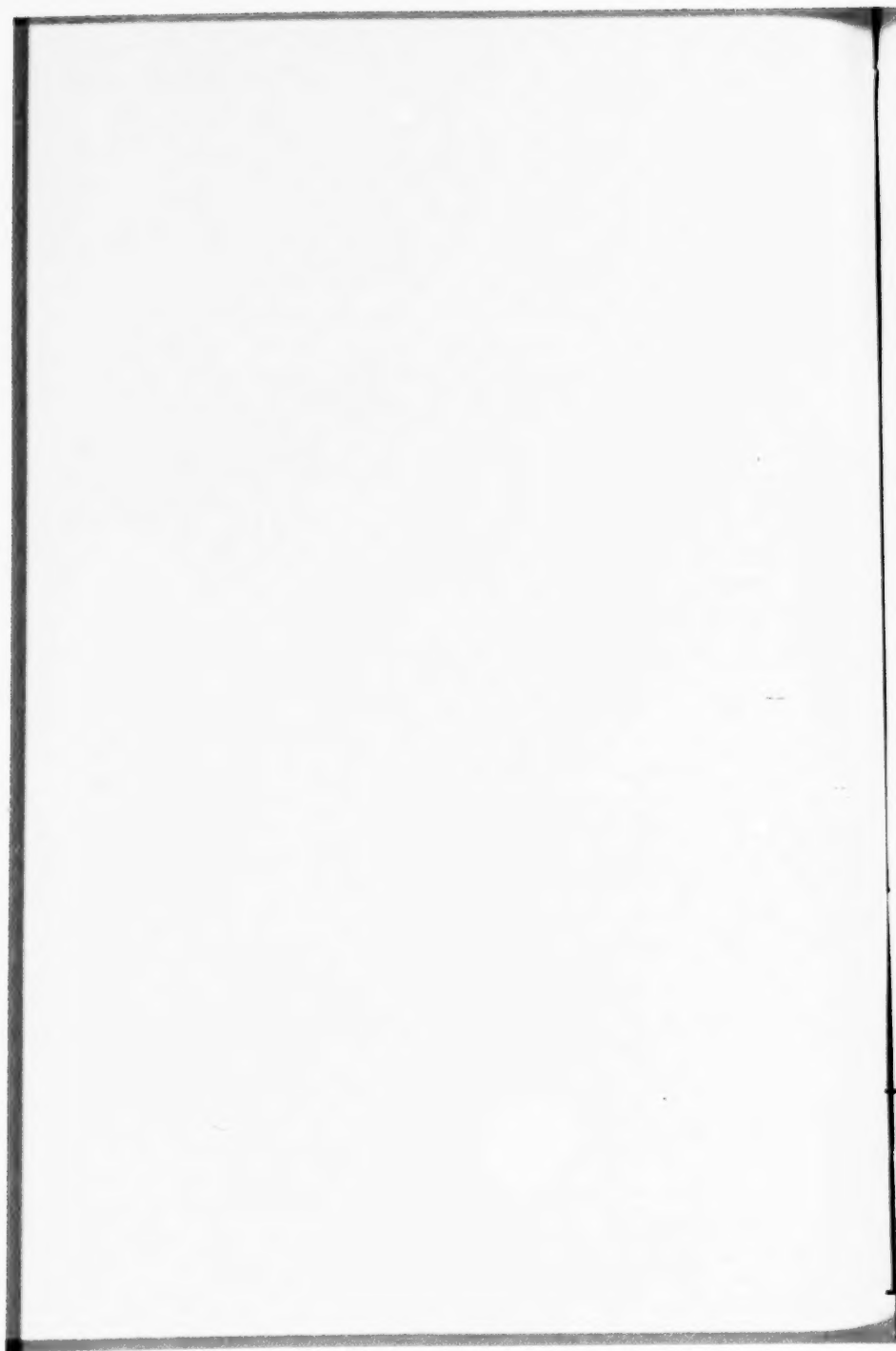
G. WESTINGHOUSE, JR.

FLUID PRESSURE AUTOMATIC BRAKE MECHANISM.

No. 376,837.

Patented Jan. 24, 1888.





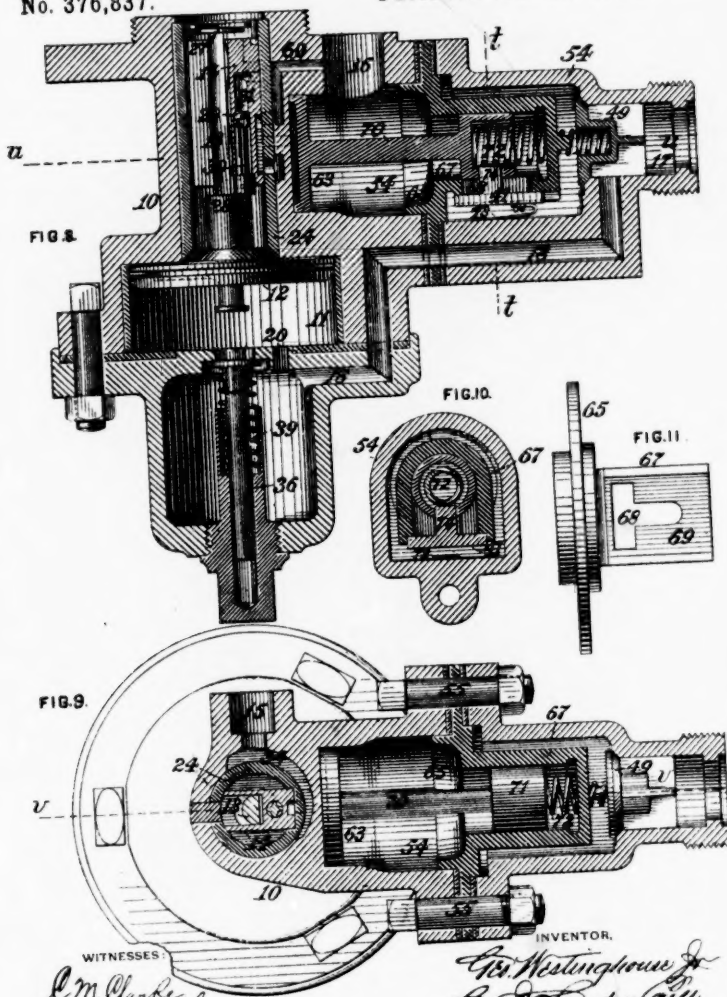
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4 Sheets—Sheet 3.

G. WESTINGHOUSE, Jr.
FLUID PRESSURE AUTOMATIC BRAKE MECHANISM.

No. 376,837.

Patented Jan. 24, 1888,



WITNESSES:
E. M. Clarke
J. E. Gaither

INVENTOR,
G. Westinghouse Jr.
By *J. S. Thurston* Att'y.

*No 403 & 426 }
Westinghouse Co } p. 1792
Troyden Co.*

(No Model.)

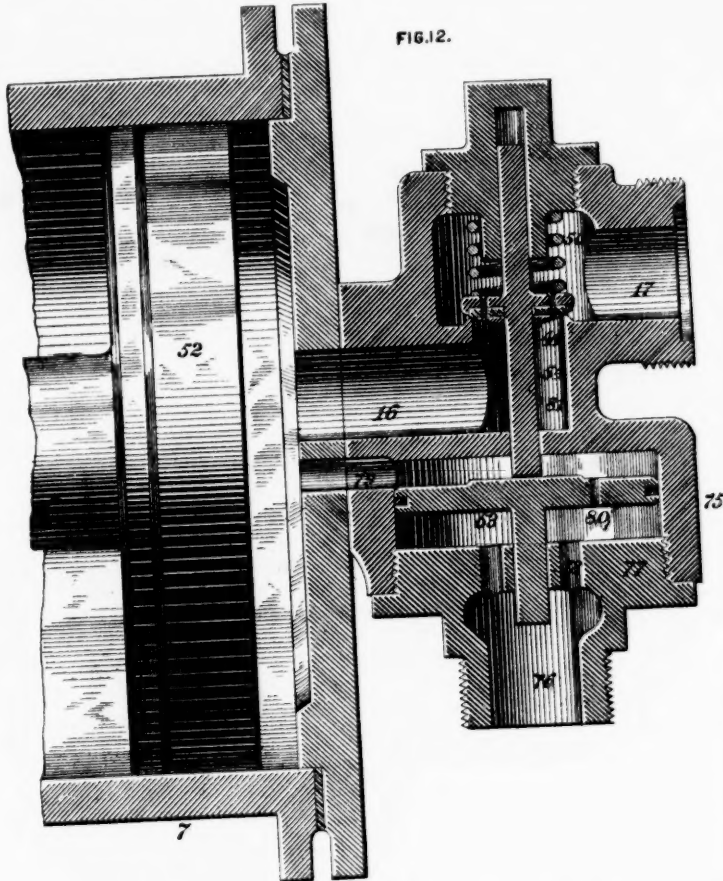
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G. WESTINGHOUSE, Jr.

FLUID PRESSURE AUTOMATIC BRAKE MECHANISM.

No. 376,837.

Patented Jan. 24, 1888.



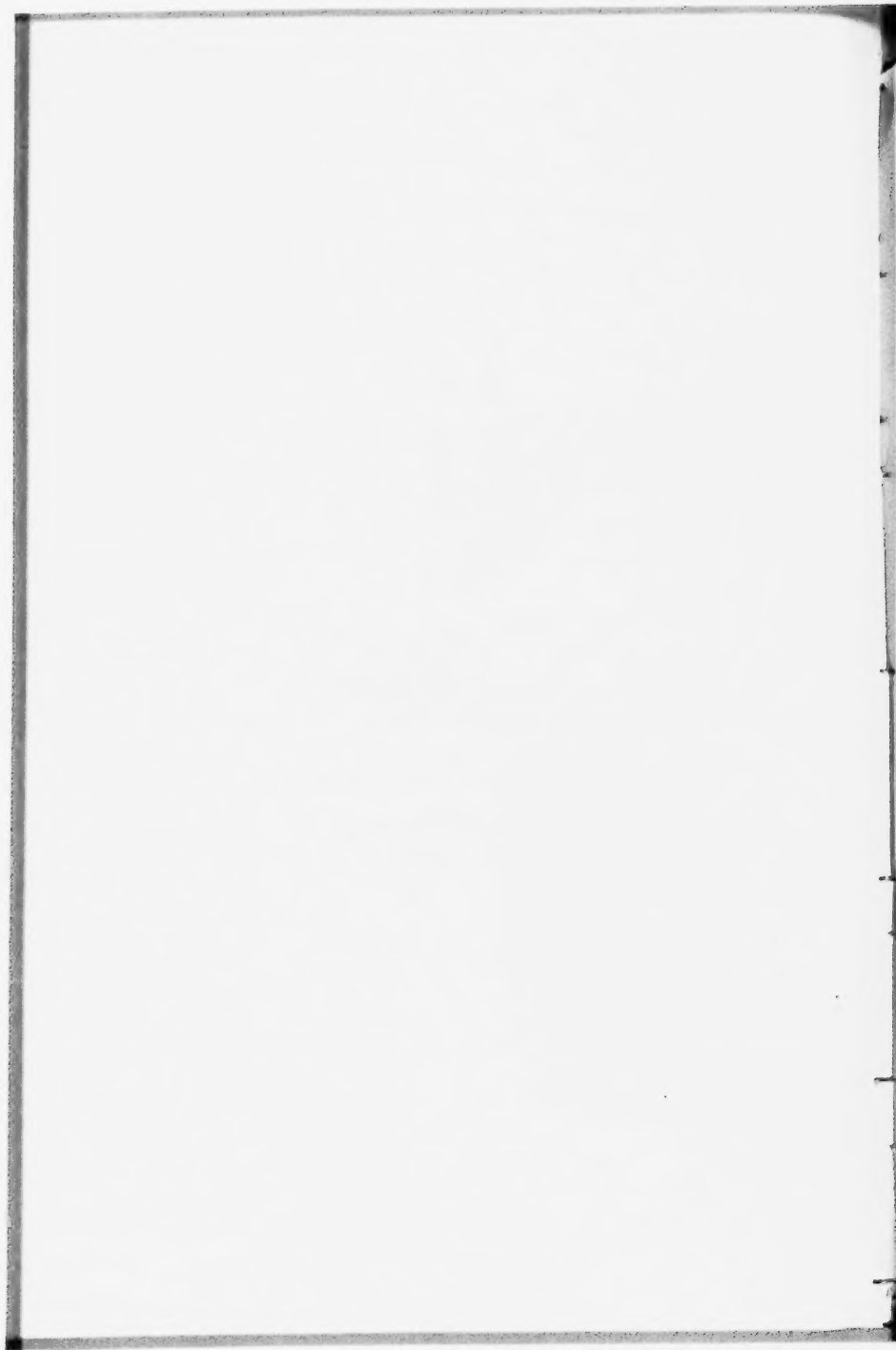
WITNESSES:

*E. M. Clarke
J. E. Gaither*

INVENTOR,

*G. Westinghouse, Jr.
By J. Thomson Bell.*

ATT'Y.



dated March 29, 1887. The operative mechanism of the triple valve proper is, as in said letters patent, inclosed within a case or chest, 10, which in this instance is secured to one end of the auxiliary reservoir 6, to the opposite end of which the brake-cylinder 7 is connected. The triple-valve case, auxiliary reservoir, and brake-cylinder are fixed in any convenient position on or under the sills or lower framing, 1, of the car, to which the main air or brake pipe 2, having the usual flexible connections and couplings, is likewise secured, and the brake-cylinder is fitted with a piston by the movements of which, through proper lever-connections, the brake-shoes are applied to and released from the wheels of the car.

The portion of the triple-valve case 10 which adjoins the auxiliary reservoir 6 is lined with an open-ended valve-bushing, 24, on which is formed the seat or valve face of the main slide-valve 14, the bushing 24 forming a chamber within which the valve is fitted to reciprocate, said chamber communicating at one end with the auxiliary reservoir and at the other with a bushing 11, forming the chamber of a piston, 12, secured upon the stem 13 of the valve 14. A cap or drain-cup, 19, is secured upon the end of the valve-case 10, in which the bushing 11 is fixed, and communicates with the chamber inclosed by said bushing through a series of ports, 20. A supplemental valve-chamber, 54, is cast upon or secured to the triple-valve case 10 on one side of the valve-bushing 14, said chamber being preferably formed in two sections, as shown, the inner of which is cast upon the triple-valve case and provided with lugs to which the outer or cap section is secured by bolts 55. The chamber 54 communicates by a passage, 17, with the main air or brake pipe 2, and by a passage, 16, with the brake-cylinder 7, communication between the passages 16 and 17 being opened and closed as required in setting and releasing the brakes by interposed valves 41 and 49, as hereinafter described.

The valve-bushing 24 is provided with ports 56, 57, 58, and 59, all of which are governed by the main slide-valve 14. The port 56 communicates with a channel or passage, 60, leading into the brake-cylinder passage 16. The ports 57 and 58, which are located in line transversely in the bushing, communicate with passages 61, (indicated in dotted lines in Figs. 2 and 3,) leading into the supplemental valve-chamber 54, and the port 59 communicates with a channel, 31, leading to the relief or exhaust port 15. The main slide-valve 14 is provided with a longitudinal passage, 31, extending from its end adjacent to the piston 12 to a point on its face, said passage being governed by a graduating-valve, 29, secured upon a stem, 30, which is fixed to the valve-stem 13 and receives a limited degree of traverse independently of the main slide-valve 14 in order to open and close the passage 31. To this end the collar 27 and shoulder 28 of the valve-stem by which the valve 14 is moved are, as heretofore, set at a distance apart slightly greater than the length of the valve. A lateral port, 32, establishes communication between the valve-face end of the passage 31 and the interior of the bushing 24 and auxiliary reservoir 6 when the graduating-valve 29 is moved off its seat in the passage 31.

A lateral recess or cavity, 66, is formed in the face of the valve 14 adjacent to the opening of the passage 31, in position to register with the port 58 when brought in line therewith in the movements of the valve, and an exhaust recess or cavity, 62, which is widened at one end to extend over the openings of both the ports 57 and 58, is formed in the face of the valve 14 adjoining its opposite end. The exhaust-recess 62 serves in one position of the valve to establish communication between the brake-cylinder and the release-port 15 through the passages 60 and 34, and in another to put the bottom of the supplemental valve-chamber in communication with the release-port through the passages 61, 57, 58, and 59. A supplemental port or passage, 35, leads from the end of the valve 14 adjacent to the auxiliary reservoir to a point on the face of the valve so located that at the limit of the traverse of the valve-stem and valve 14 in the application of the brakes communication will be established between the auxiliary reservoir and the brake-cylinder through the passages 35, 60, and 16.

A supplemental piston, 63, which may be provided with a packing-ring, is fitted to traverse in the end of the supplemental valve-chamber 54 adjacent to the triple-valve case 10, and in its movement outwardly therefrom to bear against the stem 64 of a supplemental valve, 41, which opens outwardly or in the direction of the brake-pipe passage 17, and is seated upon and over an opening in a transverse partition, 65, interposed between the two sections of the valve-chamber 54. A check-valve, 49, which opens inwardly and is seated adjacent to the outer end of the valve-chamber 54, governs communication between the same and the passage 17, leading from the brake-pipe thereto. A spring, 50, bears at its ends upon the stems of the valves 41 and 49, and acts to hold the same to their respective seats during such periods as a substantial equilibrium of pressure is maintained in the brake-cylinder and brake-pipe and when the valve 41 is not subjected to pressure by the piston 63. The check-valve 49 may, if desired, be omitted, the supplemental valve 41 being in such case held to its seat by a spring sufficiently strong to retain within the brake-cylinder a sufficient pressure to stop the train in the event of a rupture of the brake-pipe or of the escape of air therefrom by the train breaking in two.

In operation the application of the brakes under such fraction of the maximum force as is required for making ordinary stops is effected, as in my prior constructions, by discharging a portion of the air from the brake-pipe through the engineer's valve, the preponderance of pressure thereby induced in the auxiliary reservoir moving the piston 12, stem 13, and main slide-valve 14 in the direction of the drain-cup 19 until such movement is arrested by the decrease of pressure in the auxiliary reservoir or by the tension of the spring 39 on the stem 36, against which the stem 13 abuts. The graduating-valve 29 having been meanwhile unseated by the movement of the stem, compressed air from the auxiliary reservoir passes through the port 32, passage 31, passage 60 (with which in this position of the valve 14 the passage 31 communi-

cates,) and passage 16 to the brake-cylinder 6, forcing out the piston thereof and through the usual connections applying the brakes.

In making emergency stops, or when it is desired to apply the brakes with the greatest rapidity and greatest available force, sufficient air is discharged by the engineer to effect a sudden and material reduction of pressure—as, say, twenty pounds per square inch—in the brake-pipe, the effect of which is to force the piston 12 and main slide-valve 14 to the extreme limit of their stroke in the direction of the drain-cup 19. When in such position, the port 58 of the valve-bushing 24 will be opened by the valve-recess 66 and the port 57 by the port 32 and passage 31, permitting the passage of air from the auxiliary reservoir through the ports 57 and 58 and communicating passages 61 to the supplemental valve-chamber 54 on the inner side of its piston 63. The pressure thereby exerted upon the piston 63 forces the latter outwardly, its bearing in its outward movement upon the stem 64 of the supplemental valve 41 raising the latter from its seat, upon which the preponderance of pressure in the brake-pipe and connected passage 17 opens the check-valve 49 and admits air directly from the brake-pipe to the brake-cylinder through the passage 17, chamber 54, and passage 16.

It will be observed that the passages 17 and 16 may be made of as large diameter as desired without interfering with other portions of the mechanism, and that the traverse of the air from the brake-pipe to the brake-cylinder is comparatively short and direct.

When the main slide 14 has been brought into position 1295 to effect the admission of air from the brake-pipe to the brake-cylinder, as above described, its port 35 is in communication with the ports 56 and 60 and the pressure theretofore exerted in the brake-cylinder is augmented by that existing in the auxiliary reservoir, the air from which passes to the brake-cylinder through the ports 35, 56, and 60. Upon the reduction of pressure in the brake-pipe below that in the brake-cylinder the check-valve 49 is seated by the higher pressure on its inner side and by the spring 50, or, if equilibrium of pressure exists in the brake-pipe and brake-cylinder, by the spring 50, thereby preventing the return of air from the brake-cylinder to the brake-pipe.

In releasing the brakes the pressure in the brake-pipe is reinstated by the admission of air from the main reservoir, when the increased pressure, acting through the passage 17 and 18 and openings 20 upon the adjacent side of the piston 12, forces the latter and the connected main slide-valve 14 in the opposite direction, the first effect of which movement is to open the ports 61, 57, and 58 to the release-port 15 through the exhaust-cavity 62 of the valve 14, when the piston 63 is moved inwardly by the pressure upon its outer side, releasing the supplemental valve 41, which, together with the check-valve 49, is seated by the spring 50, thereby closing communication between the brake-pipe and brake-cylinder. The further movement of the valve 14 opens the passage 60 to the exhaust through the recess 62 and allows the air to escape from the brake-cylinder through said passage and recess, when the piston of the brake-cylinder is returned to its original position by a spring, releasing

the brake-shoes in its backward movement. The auxiliary reservoir is recharged, as heretofore, by air which passes through a small feeding groove in the chamber of the piston 12.

Figs. 8 to 11 show a modification in which a different form of supplemental valve is employed, the same being of the slide instead of the puppet type, as in the case first described. In this instance a central chamber, 67, is formed upon the partition or division plate 65 of the supplemental valve-chamber 54, the chamber 67 being open at its inner end to the section of the chamber 54 which is provided with the brake-cylinder passage 16, and communicating by a lateral port or opening, 68, formed in a valve face or seat, 69, on its side, with the outer section of the chamber 54, or that into which the brake-pipe passage 17 leads. The stem 70 of the piston 63 is prolonged to extend into the chamber 67, and carries a head, 71, fitting therein. A spring, 72, which bears against the head 71 and the end wall of the chamber 67, maintains the piston 63 at the inner extremity of its traverse, except when the piston is moved by the pressure of air admitted through the ports 61, as previously described. The supplemental valve 41 is a flat slide, which works on the valve-face 69, and is held to a proper bearing thereon by a spring, 73. The valve 41 is reciprocated to open and close, as required, the port 68 by the piston 63, a projection, 74, in the valve, which traverses in a longitudinal extension of the port 68, engaging a recess on the side of the head 71 of the piston-stem 70. A check-valve, 49, which opens inwardly and is seated by a spring, 50, is fitted to seat in the outer end of the chamber 54, and controls communication between the chamber 54 and brake-pipe passage 17. The operation is similar to that first described, the supplemental valve 41 being moved to open the port 68 by the piston 63 on the application of pressure to the latter from the auxiliary reservoir through the ports 57, 58, and 61 in the movement of the main slide-valve 14, and the check-valve 49 being thereupon opened by the pressure of air in the brake-pipe and passage 17 and admitting the same to the chamber 54 and brake-cylinder passage 16.

Another modification of my invention (shown in Fig. 12) is designed for use in connection with the ordinary or any desired form of triple valve for the purpose, as in the previous instances, of effecting quick and powerful action when required. The supply of air from the auxiliary reservoir and triple valve to the brake-cylinder 7 in the application of the brake, and its exhaust from the brake-cylinder in their release, is in this case effected through a piston-chamber, 75, which communicates with the triple valve by a passage, 76, formed on or fixed to its head or end plate, 77, and by ports or openings 78, leading out of said passage and through the head 77. The opposite end of the piston-chamber 75 communicates with the brake cylinder by a passage, 79, and a piston, 63, is fitted to work in the chamber between the ports 78 and passage 79. A port, 80, extends through the piston 63, said port being of a diameter not exceeding that which will suffice to admit and exhaust air to and from the brake-cylinder in ordinary braking—that

is to say, where full braking power is not desired to be exerted—so that in such case the air may pass directly to the piston of the brake-cylinder without moving the piston 63, while the sudden admission of a greater volume of air will impart movement to the piston. A valve-chamber, 54, which is connected or adjacent to the piston-chamber 75, communicates with the brake-cylinder 7 by a passage, 16, and with the main air-brake pipe by a passage, 17, communication between said passages being governed by a supplemental valve, 41, which opens outwardly or in the direction of the brake-pipe passage 17, and is normally seated by a spring, 50. The valve 41 is fixed upon a stem, 81, which extends into the piston-chamber 75 and bears at its end upon the piston thereof. The passage 17 may be provided with an ordinary check-valve opening inwardly to prevent the return of air from the brake-cylinder on a diminution of the pressure in the brake-pipe below that in the brake-cylinder.

In ordinary braking, air from the auxiliary reservoir and triple valve passes through the passage 76, ports 78, piston-chamber 75, and ports 80 and 79 into the brake cylinder to effect the application of the brakes, and is similarly discharged to the exhaust in their release. When the brakes are to be applied quickly and with full force, a greater quantity of air is suddenly admitted to the piston-chamber 75, and, not finding sufficient discharge through the port 80, moves the piston 63 in the direction of the valve 41, and through the stem 81, unseats said valve and admits air directly to the brake-cylinder from the brake-pipe through the passages 17 and 16 and chamber 54, as in the instances before described. In the release of the brakes the valve 41 is seated by the spring 50.

I claim as my invention and desire to secure by letters patent—

1. In a brake mechanism, the combination of a chamber or casing having direct connections to a brake-cylinder and to a brake-pipe, respectively, a valve controlling communication between said connections, and a piston or diaphragm which is independent of and unconnected with a triple-valve piston and is actuated by pressure from an auxiliary reservoir in direction to impart opening movement to said valve, substantially as set forth.

2. In a brake mechanism, the combination of a chamber or casing having direct connections to a brake-cylinder and to a brake-pipe, respectively, a valve controlling communication between said connections, a piston or diaphragm which is independent of and unconnected with a triple-valve piston and is actuated by pressure from an auxiliary reservoir in direction to impart opening movement to said valve, and a check or non-return valve controlling communication between said valve and the brake-pipe passage of the chamber, substantially as set forth.

3. In a brake mechanism, the combination, with a triple valve, of a supplemental chamber or casing having passages leading to a brake-cylinder and to a brake-pipe, respectively, a supplemental valve controlling communication between said passages, a supplemental piston operating independently of the triple-valve piston and adapted to impart opening movement to said supplemental

valve, and a passage establishing communication between said supplemental piston and an auxiliary reservoir, substantially as set forth.

4. In a brake mechanism, the combination, with a triple valve, of a supplemental chamber or casing having passages leading to a brake-cylinder and to a brake-pipe, respectively, a supplemental valve controlling communication between said passages, a piston adapted to impart movement to said valve, and a passage establishing communication between said piston and an auxiliary reservoir through the main slide-valve of the triple-valve mechanism, substantially as set forth.

5. In a brake mechanism, the combination of a triple valve having its main slide-valve and valve-bushing provided with ports and passages for the admission and exhaust of air from an auxiliary reservoir to and from a brake-cylinder and to and from a supplemental valve-chamber, a supplemental valve-chamber connected to the slide-valve chamber of the triple valve and having passages leading to the brake-cylinder and to the brake-pipe, respectively, a supplemental valve governing a port or opening in a partition of said chamber between said passages, a piston fitting said chamber above a port leading to the main slide-valve chamber in position to impart movement to the supplemental valve, a check-valve governing the brake-pipe passage of the supplemental valve-chamber, and a spring or springs acting to seat the supplemental and check valves, substantially as set forth.

6. In a brake mechanism, the combination of a triple-valve casing, a supplemental valve-chamber composed of an inner section which is formed integral with the triple-valve casing and a separable outer section, each having a lateral air pipe or passage, and a supplemental valve-seat formed in a division plate or partition interposed between and secured to the two sections of the supplemental valve-chamber, substantially as set forth.

In testimony whereof I have hereunto set my hand.

GEO. WESTINGHOUSE, JR.

Witnesses:

J. SNOWDEN BELL.

W. D. UPTGRAFF.

(No Model.)

3 Sheets—Sheet 1.

G. A. BOYDEN.
VALVE FOR AIR BRAKES.

No. 481,134.

Patented Aug. 16, 1892.

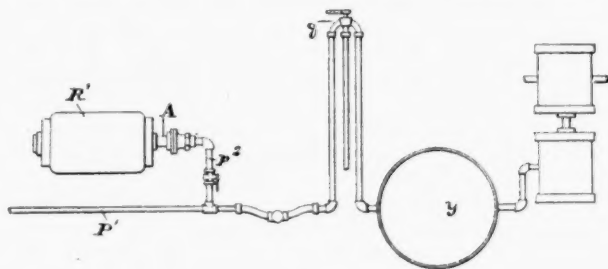


Fig. 1.

No. 4030426.
Westinghouse Co. } p 1298
Boyden Co.

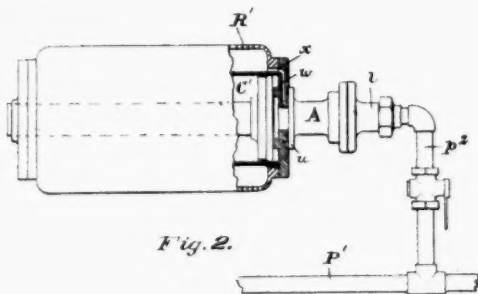


Fig. 2.

Witnesses

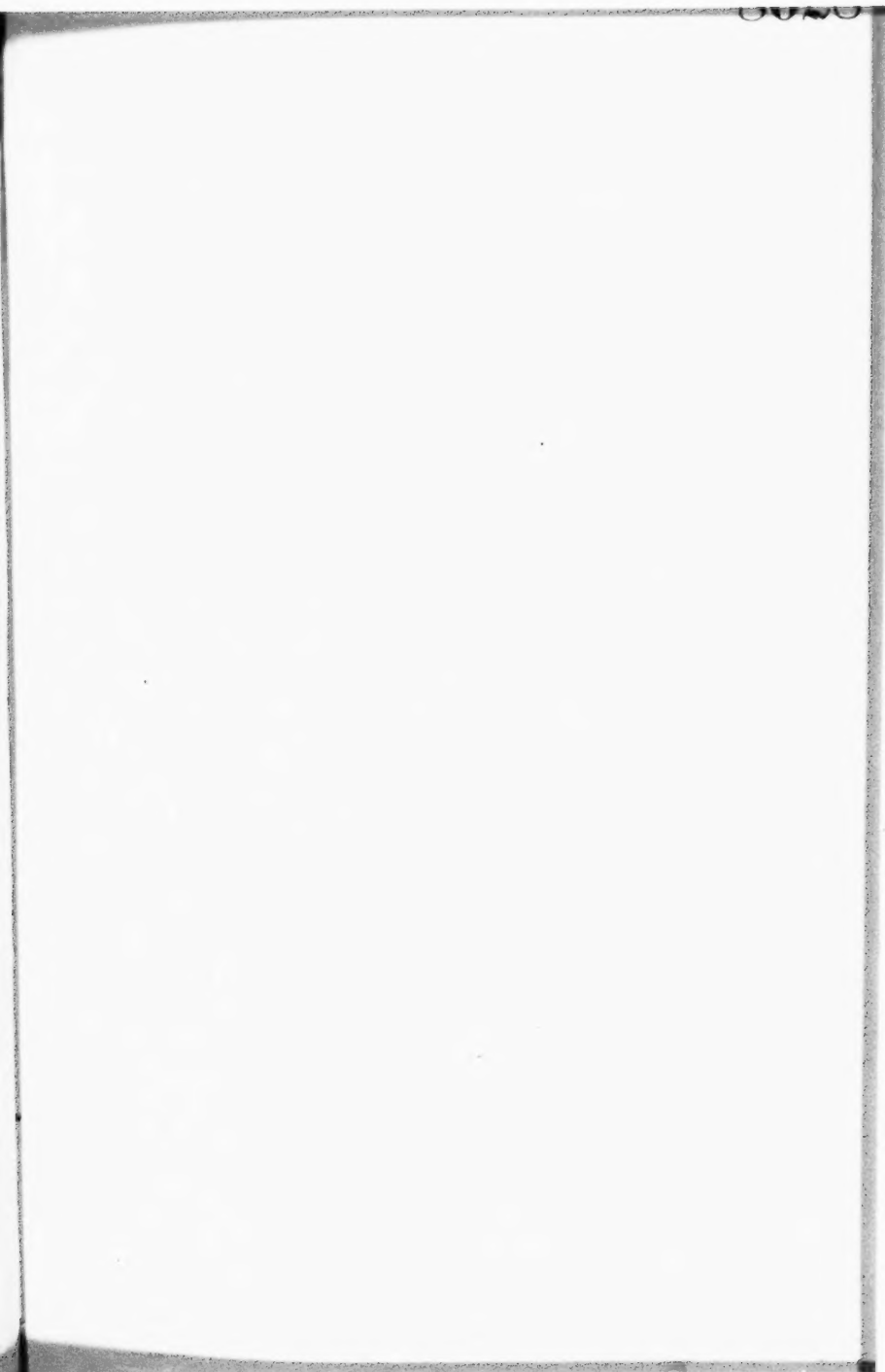
A. O. Babcock.
John E. Morris

Inventor

G. A. Boyden

By his Attorney

Chas. B. Mann



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(No Model.)

3 Sheets—Sheet 2

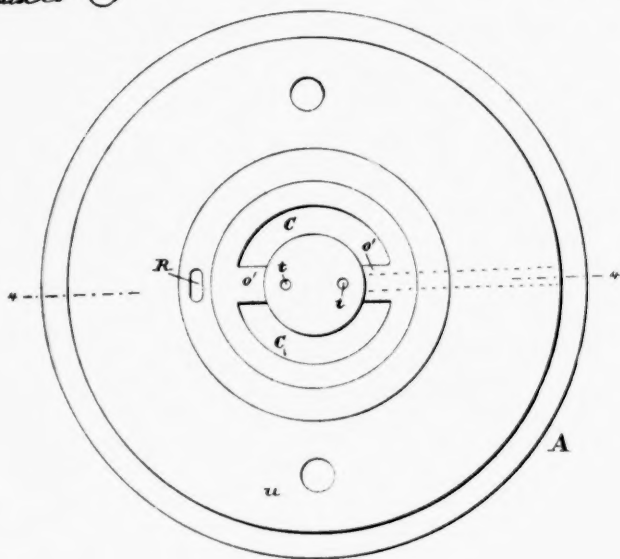
G. A. BOYDEN.
VALVE FOR AIR BRAKES.

No. 481,134.

Patented Aug. 16, 1892.

*No. 481,134
Westinghouse Co. }
Boyd & Co. } 1300*

Fig. 3.



Witnesses

*A. C. Balendruier
John E. Morris.*

Inventor

Geo. A. Boyden

By his Attorney

Chas. B. Mann

(No Model.)

3 Sheets—Sheet 3.

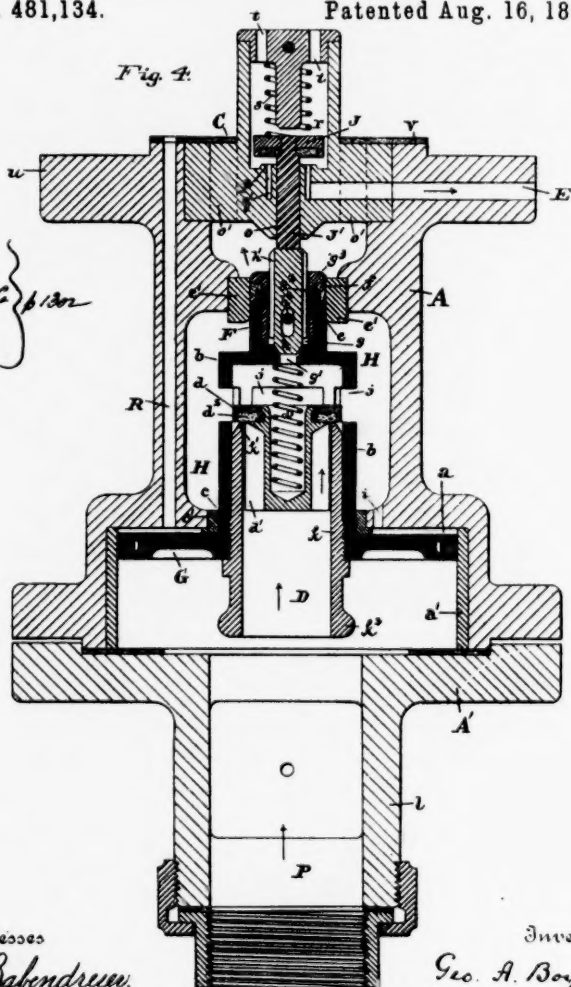
G. A. BOYDEN.
VALVE FOR AIR BRAKES.

No. 481,134.

Patented Aug. 16, 1892.

Fig. 4.

No 481134
Huntington & Co }
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1303

UNITED STATES PATENT OFFICE.

GEORGE ALBERT BOYDEN, of Baltimore, Maryland, assignor to the Boyden Brake Company of Baltimore City, of Maryland.

Valve for Air-brakes.

Specification forming part of Letters Patent No. 481,134, dated August 16, 1892. Application filed September 30, 1889. Serial No. 325,474. (No model.)

To all whom it may concern:

Be it known that I, George Albert Boyden, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful improvements in valves for air-brakes; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to improvements in valve mechanism of automatic air-brake systems, and has for its principal object to provide for the admission of air-pressure to the brake-cylinder from both the train-pipe and the auxiliary reservoir, so as to affect a powerful application of the brakes, and at the same time produce a reduction of air-pressure in the train-pipe adjacent to the valve mechanism to quicken the application of succeeding brake mechanisms, so that the brakes on all the cars of the train will be applied at nearly the same instant.

In my patent of June 26, 1883, No. 280,285, I brought out an improved triple-valve mechanism having a check-valved passage from the train-pipe so arranged as to admit train-pipe air direct to the brake-cylinder at the same time that auxiliary-reservoir air is in the brake-cylinder. In my present invention I use the check-valved feed-passage of my 1883 patent, leading from the train-pipe through the triple-valve piston to the main valve-chamber, and thence both to the auxiliary reservoir and the brake-cylinder for the double purpose of supplying the auxiliary reservoir and also enabling train-pipe air to be vented directly through the main valve-chamber into the brake-cylinder to aid in applying the brakes in emergency stops.

Referring to the drawings,

(Here follow diagrams marked pp. 1298, 1300, & 1302.)

Figure 1 is an elevation showing the principal elements comprising an ordinary air-brake system and the application thereto of the improved valve mechanism by which the air-pressure is controlled. Fig. 2 is a view illustrating an air-brake cylinder, an auxiliary reservoir, a portion of the train-pipe, and the valve mechanism for controlling the air-pressure in the brake-cylinder,

the same representing the equipment of a single car. Fig. 3 is a view of the valve, looking toward the inner end, which is attached to the brake-cylinder. Fig. 4 is a longitudinal section through the valve mechanism on the line 4 4.

Similar letters of reference in the several figures indicate the same parts.

The brake system in general to which my present improvements are shown applied is that in common use, and includes, in addition to the brake-cylinder *C'*, auxiliary reservoir *R'*, and train-pipe *P'*, (illustrated in Fig. 2,) the usual equipment of the locomotive—such as an air pump or compressor, a storage-tank, and an engineer's valve *q*—all of which parts are familiar to persons skilled in the construction and operation of brake mechanisms.

In addition to the parts named a complete automatic air-brake system includes as one of its essential elements a valve mechanism located on each car and serving to control the admission and escape of air in the brake-cylinder for effecting the application and release of the brakes. This valve mechanism is popularly known as a "triple valve," and the present improvements relate more particularly to this element or part of the brake system and introduces a new mode of operation.

The valve-case shown comprises two pieces, the body part *A* and the head *A'*, which are suitably secured together. The open end *C* of the valve-case is attached in the present instance to the brake-cylinder *C'* by bolts passing through flange *u*, with an interposed gasket *v* for making a tight joint. The passage *R* connects with the auxiliary reservoir *R'*, the passage *P* with a branch *p*² of the train-pipe, and the passage *E* is for the exhaust from the brake-cylinder.

To economize space under the car, the auxiliary reservoir *R'* may be placed around the brake-cylinder *C'*, as shown, instead of being removed or separate therefrom, as is usual, and when so arranged communication is established between the auxiliary reservoir and the improved valve mechanism through a passage *w* in the head *x* of the brake-cylinder. It will be obvious, however, that it is

1304 not necessary to the operation of my improvements that the auxiliary reservoir should be thus constructed and arranged, as the usual forms of auxiliary reservoir and brake-cylinder will operate in unison with the improved valve mechanism with equal advantages.

The valve-case is provided with a piston-chamber *a* in open communication with the train-pipe connection or passage *P*, and in the present instance, this chamber is furnished with a bushing or lining *a'*, within which is fitted a piston *G*, having a central tubular extension *b* of smaller diameter than the piston and entering the valve-chamber *H* through an opening *c* at one end. This opening *c* is furnished with a bushing *c'*, which also serves as a guide for the said tubular extension *b*, which projects through it into chamber *H*. At its end this extension is furnished with a valve *F*, co-operating with the main valve-port *e* at the end of said chamber. This valve-port is formed by a bushing *e'*. When the port *e* is

open, air may pass from the valve-chamber H to the brake-cylinder C' by the openings C. The valve F is operated to open and close communication with brake-cylinder C' from both the auxiliary reservoir R' and train-pipe P'.

The main valve F is of the kind known as a "plug-valve," and is provided with a suitable packing *f* to make an air-tight fit in the port through the bushing *e'*. This valve F has a chamber *g*, terminating in a small port *g'*, and said chamber is lined by a tube *g*², provided with an end flange *g*³ for confining the packing *f*. The said small port *g'* serves to establish communication between the valve-chamber H and the brake-cylinder C' when the main valve F is in its closed position. This small port *g'* is controlled by the graduating-valve *h*, which has suitable grooves *h'* on its sides and fits movably in the lining-tube *g*². The conical end of the graduating-valve *h* is adapted to fit air-tight over the small port *g'*, and when unseated or moved to uncover the said port compressed air will pass from the valve-chamber H along the grooves *h'* and then to the brake-cylinder. The stem of the graduating-valve has a cross-slot, through which passes a pin *h*² for limiting the movement of the graduating-valve, and also serving to hold the lining-tube *g*² in position. The end of the stem of the graduating-valve projects beyond the lining-tube *g*², and when the main valve F is entered within the main port *e* sufficiently far the projecting end of the stem of said graduating-valve engages the stem *J'* of the release-valve.

The auxiliary reservoir R' and piston-chamber *a* are in communication through the passage R, formed in the valve case. Said passage supplies air on the side of piston G which is opposite the train-pipe passage P. This passage R does not lead through the valve-chamber H. The passage R between the piston-chamber and auxiliary reservoir is larger or of greater capacity than the passage *i*, through which air from the auxiliary reservoir is admitted to the valve-chamber H. The said passage *i*, through which auxiliary-reservoir air is conducted to the valve-chamber H in applying the brakes, is smaller—that is, it has a less transverse area and a restricted or smaller conducting capacity—than either the said passage R or the main port *e*, and it can conveniently be located, as shown, in the partition where the guide-bushing *e'* is fixed, which partition serves to separate or isolate the auxiliary-reservoir side of the piston-chamber *a* from the valve-chamber H, and thus makes it possible when applying the brakes in an emergency for the piston G to be subjected on its auxiliary reservoir side to a greater air-pressure than that contained in the valve-chamber H. A passage D is formed through the piston and extends from the train-pipe side of the piston-chamber *a* to the valve-chamber H, and in said passage is located a check-valve *d*, which is arranged to allow compressed air to pass from the train-pipe P' to the auxiliary reservoir R' for charging, and when the main valve-port *e* is open from the train-pipe direct to the brake-cylinder for quick action in emergency applications of the brakes; but said check-valve prevents air pass-

ing from the auxiliary reservoir and brake-cylinder back to train-pipe.

The construction of the check-valve *d* and its coacting parts may be varied from that shown. In the present instance guide-wings *d'* are connected to the valve, and the latter carries a packing *d²*. The check-valve is recessed, and a spiral spring *d³*, seated in said recess, presses the check-valve and keeps it normally on its seat *k'*, and when thus seated communication between the valve-chamber *H* and the brake-pipe is closed. The check-valve *d* is located in the tubular extension *b* of the piston, and passages *j* in said tubular extension *b* permit train-pipe air to pass into the valve-chamber *H*. In the tubular extension an internal tube or lining *k* is fitted, one end of which serves as a seat *k'* to the check-valve, while the other end *k²* projects at the opposite side of the piston *G* and serves as a handle or grasp part. The guide-wings *d'* of the check-valve slide in the internal tube *k*.

The check-valved passage *D*, through which train-pipe air flows when applying the brakes for an emergency stop, has a much greater area or capacity than the small passage *i*, through which the auxiliary-reservoir air flows. The nozzle *l*, for connection with the train-pipe *P'*, is formed on the head *A'* of the valve-case, and air under pressure is conducted from the train-pipe through said nozzle.

The exhaust-passage *E*, through which air is discharged from the brake-cylinder *C'* to the atmosphere to release the brakes, is controlled by a release-valve *J*, having a stem *J'*, sliding in a bearing *o*, which latter is supported by bridge-pieces *o'*. This passage extends through one of the bridge-pieces *o'*, and the openings 1305 *C* at the sides of said bridge-pieces form supply-passages communicating with the brake-cylinder. The release-valve *J* is in line with the graduating and main valves *h* and *F*, and these valves are so arranged that when the main valve is fully closed the end of the stem of the graduating-valve presses the stem *J'* of the release-valve and lifts the latter from its seat *p*. This valve-seat *p* is provided with a port *q'* in communication with a chamber *r* on one side and the exhaust-passage *E* on the other. The release-valve *J* is located within this chamber *r*, and the latter is in open communication with the brake-cylinder through passages *t*. A spiral spring *s* engages the release-valve and tends to keep it to its seat *p*.

It is well understood, that in valves of this general character a flexible diaphragm may be used as a recognized equivalent of the piston *G*. This and other equivalent changes may be made without in anywise departing from the present invention. In the present embodiment the valve-case is bolted by its flange to the head of the brake-cylinder in such manner that the passages *t*, communicating with the exhaust-passage, and the supply-openings *C*, communicating with the main and graduating valve-ports, will open to the brake-cylinder, while the large passage *R* is placed in communication with the auxiliary reservoir through a passage *w*, which in this instance is in the cylinder-head.

The operation of this improved valve mechanism is as follows: To charge the auxiliary reservoir and prepare the brakes for action, compressed air from the train-pipe entering through connecting-nozzle *l* acts upon the piston G and moves said piston, so that the graduating-valve *h* and the main valve F will close their respective ports and thus cut off communication with the brake cylinder C'. The exhaust-valve J will at the same time be moved to uncover its port, and the check-valve *d*, yielding to the preponderance of pressure exerted on its train-pipe side, will unseat, and air from the train-pipe will be conducted by passages D, *j*, *i*, and R to the auxiliary reservoir R'. An approximate equalization of air-pressure will thus be brought about in the auxiliary reservoir R', valve-chamber H, and train-pipe, and the check-valve will be seated. When it is desired to gradually apply the brakes, the handle of the engineer's valve *q* will be moved for a moment to such a position that communication between the storage-tank *y* on the locomotive and the train-pipe P' will be closed and an escape-orifice opened to the atmosphere. Thereby the air-pressure in the train-pipe will be reduced slightly—say about five pounds or less. This reduction of pressure on the train-pipe side of the piston G disturbs the balance previously existing on opposite sides thereof, resulting in establishing a preponderance of air-pressure on the auxiliary-reservoir side, and the air delivered from the auxiliary reservoir through the passage R and acting upon the piston G causes the latter and its attached parts to move outward and permit the release-valve J to seat, thereby closing communication between the brake-cylinder C' and the exhaust-passage E. This outward movement of the piston G will continue after the release-valve J has become seated and until the graduating-valve *h* has been unseated by the pressure of air in the valve-chamber H, thus allowing auxiliary-reservoir air to flow through small port *g'* into the brake-cylinder C', where it acts upon the piston thereof to effect the application of the brakes. When by reason of the flow of air into the brake-cylinder the pressure in valve-chamber H and in auxiliary reservoir R' has been reduced to or below that in the train-pipe, a slight return or inward movement of the piston G will be produced sufficient to cause the reseating of the graduating-valve *h*, and thus close communication between valve-chamber H and the brake-cylinder and confine the air admitted within the latter. In case it is desired to gradually increase the air-pressure in the brake-cylinder, the above-described operation is repeated. To permit the air in the brake-cylinder to escape and effect the release of the brakes, the air-pressure in train-pipe is restored or increased by a proper movement of the engineer's valve. The increase of pressure in the train-pipe causes the piston G to move inward to the limit of its stroke, when it will occupy the position illustrated in Fig. 4, thereby raising the release-valve J from its seat and placing the brake-cylinder in communication with the exhaust-passage E and allow the air to escape. At the same time the restoration of pressure in the train-pipe will unseat the check-valve *d* and air from the train-pipe will flow into the auxiliary reservoir, recharging the latter for future use. The recharging will

continue until the pressure in the auxiliary reservoir equals that in the train-pipe, when the check-valve will be seated by its spring. When it becomes necessary or desirable to apply the brakes of a train quickly and with full power for an emergency stop, the engineer's valve *q* will be moved to close communication between the storage-tank *y* and train-pipe and open the latter to the atmosphere and produce a sudden reduction of pressure of about ten or fifteen pounds in the train-pipe. The effect of this sudden diminution of pressure in the train-pipe is immediately manifested at the nearest valve mechanism or that on the first car, causing the valve-piston *G* to be moved by the higher pressure of auxiliary-reservoir air quickly to its full outward position, thus moving the main valve *F* and opening wide the main port *e*, so that the air-pressure contained in the valve-chamber *H* may exhaust freely into the brake-cylinder. The supply of air from auxiliary reservoir to the valve-chamber *H* is conducted through the restricted or small passage *i*. Hence when the main port *e* is opened wide and the air in valve-chamber escapes through the larger passage thus

1306 provided the pressure in said valve-chamber is quickly reduced below that in the piston-chamber *a* on the auxiliary-reservoir side. This follows because the passage *i*, supplying auxiliary-reservoir air to the valve-chamber *H*, is so much smaller than the passage *R*, supplying the same kind of air to the piston-chamber. The sudden and full opening of the main port *e* allows all or nearly all of the air-pressure on the brake-cylinder side of the check-valve *d* to escape, whereupon the check-valve will be immediately unseated and train pipe air will pass directly into the brake-cylinder *C'*, thus effecting the quick application of the brakes and also a further reduction of pressure in the train-pipe that will be sufficient to accelerate the action of the valve mechanisms on the cars following. The piston *G* will in the meantime be held to its outward position by the relatively higher air-pressure from the auxiliary reservoir, which is delivered through the large passage *R*, while the transmission of auxiliary-reservoir air to the brake-cylinder is retarded by having to pass through the relatively smaller passage *i*. During its preliminary traverse outward or toward the train-pipe side the piston *G* operates to close the exhaust-passage, and its farther or continued movement in the same direction opens the main valve *F* and allows air to pass from both the auxiliary reservoir and the train-pipe to the brake-cylinder when making a quick application of the brakes. It will be observed that the valve mechanism depends for its action upon the movements of the piston *G* and that the latter is subjected to two opposing forces—auxiliary-reservoir air on one side and train-pipe air on the other—and that its movement in one direction is effected by the preponderating pressure of auxiliary-reservoir air, while its movement in the opposite direction results from a preponderance of pressure on the train-pipe side. If the passage *i*, through which auxiliary-reservoir air must flow upon the sudden opening of the main-valve port *e* for an emergency stop, was as large as or larger than the check-valved passage for supplying train-pipe air, the quick action referred to

and the utilization of train-pipe air direct in the brake-cylinder could not be effected for the very obvious reason that the inward flow of train-pipe air at, say, fifty-five or sixty pounds, to the brake-cylinder would be opposed and checked by the flow of auxiliary-reservoir air at a higher pressure, say, seventy pounds; but by restricting the passage through which auxiliary-reservoir air is conducted in the course of its transmission to the brake-cylinder, so that its capacity for the flow of air will be less than that of the main port *e* and less than the check-valve passage leading from the train-pipe, a considerable volume of train-pipe air will flow into the brake-cylinder, notwithstanding the admission of the auxiliary-reservoir air under a higher pressure, because the flow of auxiliary-reservoir air is so retarded by the smaller passage *i*, through which it is conducted, that an appreciable period of time is required to raise the pressure in the brake-cylinder to that in the auxiliary reservoir, and it is during this interval and before the pressure in the brake-cylinder is raised to that in the train-pipe that the air in the latter is free to enter the brake-cylinder. It will thus be seen that the sudden uncovering of the main port or passage *e*, leading to the brake-cylinder, by the movement of the main valve opens communication between the train-pipe and brake-cylinder and also between the auxiliary reservoir and the brake-cylinder; but that the flow of the higher-pressure air from the auxiliary reservoir into the brake-cylinder is retarded by being compelled to traverse a relatively small orifice or passage, while the lower-pressure train-pipe air is permitted to flow through a larger orifice or passage.

From the foregoing explanation it is obvious that there is a co-action at the time of applying the brakes for emergency stops between the restricted passage which supplies auxiliary reservoir air, the larger passage which supplies train-pipe air, and the single valve which controls the communication of air from both of said passages to the brake-cylinder. As soon as the pressure above the check-valve caused by the auxiliary-reservoir air, plus the pressure of the spring *d^b*, exceeds the pressure exerted by the train-pipe air on the other side, the check-valve will close and the further ingress of train-pipe air to the brake-cylinder will be cut off, while the auxiliary-reservoir air will continue to flow, thus augmenting the pressure therein. To effect the release of the brakes, the air-pressure must be restored in the train-pipe to overcome the pressure on the auxiliary-reservoir side of the piston G, whereupon the parts will act in the manner already described.

As hereinbefore intimated, this valve mechanism belongs to the class of air-brake valves known as "triple valves," of which there are numerous examples, differing somewhat in construction and embodying variations and modifications in the form and arrangement of parts; but all of them, however specially constructed, contemplate a valve structure having suitable connections for the train-pipe, the auxiliary reservoir, and the brake-cylinder, and are provided with passages or ports leading, first, from the train-pipe to the auxiliary reservoir; second, from the said reservoir to the brake-cylinder, and, third, from the brake-cylinder to the atmos-

phers; hence the name triple valve. In some cases a plurality of valves govern these passages or ports.

It is to be observed that some of the distinguishing features of this invention are, first, that provision is made whereby train-pipe air may pass direct to the brake-cylinder through the triple valve, thus utilizing the triple-valve mechanism to effect what is 1307 known as a "quick action" of the brakes without necessitating the use of an "auxiliary" valve, as heretofore; second, quick action of the brakes is produced by the admission of both auxiliary-reservoir air and train-pipe air to the brake-cylinder by use of a single valve and properly proportioning the passages of the triple valve, so that train-pipe air at a lower pressure than that in the auxiliary reservoir may be admitted to the brake-cylinder; third, the novel mode of operation, whereby in applying the quick-action feature three different pressures are momentarily produced in the triple-valve case—that is, the highest pressure on auxiliary-reservoir side of piston, a lower pressure on the train-pipe side of said piston, and the lowest pressure where the port *e* is located, which leads to the brake-cylinder.

In the embodiment shown the main valve of the triple valve is of the reciprocating plug form, which is deemed advantageous, in that it admits of a certain extent of reciprocating movement within its port *e* without opening or uncovering the latter, so that the unintentional slight variations of air-pressure that occur in the train-pipe will be productive of no disadvantage, as the piston *G* can have a limited movement without allowing any air to pass. Another advantage of this "plug" form of valve is that it permits the closing of the release-valve before the opening of the ports controlled by it and by the graduating-valve. These specific improvements in form, while advantageous in the particulars mentioned, do not affect the new mode of operation due to the reorganization of the triple valve and which results in the addition thereto of a new function. My invention therefore is not limited to this form of valve.

As ordinarily constructed heretofore the triple valve has been arranged to effect two grades of brake application by use of auxiliary-reservoir pressure alone, these two grades differing in degree rather than in kind. The first may be called "full pressure" and the second is known as "graduation." For effecting these two grades of application a main and a graduating valve are employed, corresponding generally, though embodied in different forms, with the main graduating-valves *F* and *h* here shown. These, together with a release-valve and feeding-valve, are usually arranged to be actuated by a piston.

An example of the class of triple valves just referred to is shown in United States patent to George Westinghouse, Jr., dated October 14, 1879, No. 220,556. Triple valves of this kind and in a great variety of forms are well known; but they do not possess the quick-action principle, which utilizes train-pipe air in the application of the brakes and effects a reduction of train-pipe pressure by

so doing. On the contrary, in such valves the pressure available in the brake-cylinder is derived from the auxiliary reservoir alone.

Efforts have heretofore been made to combine with a triple valve certain additional mechanism by which train-pipe air could be introduced directly into the brake-cylinder in effecting the application of the brakes for emergency stops; but in every such instance a supplemental passage or passages, together with a supplemental or auxiliary valve, has had to be employed in connection with the triple valve proper, in order that the ordinary functions of the triple valve might be preserved and the additional function of introducing train-pipe air into the brake-cylinder for emergency stops be combined therewith.

An example of the class of valves referred to in the last preceding paragraph which employ an auxiliary valve, combined with an ordinary triple valve, is shown in United States patent to George Westinghouse, Jr., dated March 29, 1887, No. 360,970.

It will be seen that my present invention for introducing train-pipe air into the brake-cylinder for emergency stops differs essentially from the device shown in the said patent No. 360,970, because I have provided a new principle of construction and a new mode of operation, by use of which the desired result aforesaid may be produced without the aid of the auxiliary valve heretofore required for the purpose.

An examination of the particular embodiment of the present invention will disclose the fact that it is a triple valve *per se*, without auxiliary or supplemental valve devices, and, further, that its conversion into a quick-action valve and its greater capacity for action over ordinary forms of triple valves is due to means which I have invented for retarding or restricting the flow of auxiliary-reservoir air to the main port or passage leading to the brake-cylinder as compared with the more open or free delivery of train-pipe air to the said main port or passage. By thus delaying or restraining the flow of auxiliary-reservoir air it becomes possible to open both passages to the brake-cylinder, and the difference in size of these passages allows a considerable portion of the air from the train-pipe at lower pressure to enter the brake-cylinder before the air from auxiliary reservoir at higher pressure raises the pressure in the brake-cylinder to such a degree as to prevent the ingress of train-pipe air, and, further, a single valve—the main valve of the triple valve proper—is here made to perform the office of opening communication to the brake-cylinder from both the train-pipe and the auxiliary reservoir in the quick application of the brakes for emergency stops. My invention therefore includes any form of structure of valve wherein a single valve admits both train-pipe air and auxiliary-reservoir air to the brake-cylinder in applying for emergency stops, and which structure is provided with means for restricting or retarding the flow of auxiliary-reservoir air to the brake-cylinder as compared with the flow of the train-pipe air thereto.

1308 The graduating-valve *h* of the present valve mechanism performs the ordinary functions of such a device and is

brought into useful action only in making "graduation" applications of the brakes. It does not affect in any manner the "quick-action" or emergency-stop feature. Hence its presence or absence is not essential thereto.

Having thus explained the principle of my invention and described means by which it may be embodied and practiced, what I claim as new, and desire to secure by letters patent, is—

1. In triple-valve mechanism for automatic air brakes, the combination of a passage from the train-pipe, a passage from the auxiliary reservoir, which is smaller or more restricted than said train-pipe passage, and a single valve coacting with both of said passages and controlling communication between them and the brake-cylinder, whereby when an emergency application of the brakes is desired the train-pipe air and auxiliary-reservoir air, the former at lower pressure than the latter, will both pass to the brake-cylinder through the triple valve.

2. In valve mechanism for automatic air-brakes, the combination of a communication with the brake-cylinder from both the auxiliary-reservoir and train-pipe, a single valve controlling said communication, and means to retard or restrict the flow thereto of the auxiliary-reservoir air when applying the brakes in comparison with the flow of train-pipe air, whereby train-pipe air at lower pressure than said auxiliary-reservoir air will pass said valve when making an emergency application of the brakes.

3. In a triple valve, the combination, with a suitable chamber, of a port therefrom to the brake-cylinder, a valve controlling said port, and passages to the said chamber from the train-pipe and from the auxiliary reservoir, the latter passage being of less capacity than the former, whereby train-pipe air may pass direct to the brake-cylinder through the triple valve to effect quick action of the brakes for emergency stops.

4. In a valve for automatic air-brakes, the combination of a communication with the brake-cylinder, a suitable valve controlling said communication, two air-passages coacting with said valve and relatively proportioned as to their capacity to allow the flow of both train-pipe air and auxiliary-reservoir air each at a different pressure to pass said valve when open, and a check-valve to prevent the return of air to the train-pipe.

5. A valve for controlling automatic air-brakes, having, in combination, a piston which is moved in one direction by pressure from the train-pipe and in the other direction by pressure from the auxiliary reservoir, a valve-chamber which has a check-valved communication from the train-pipe, a communication with the auxiliary reservoir, and a port communicating with the brake-cylinder, said port being of greater area or capacity than the said communication with the auxiliary reservoir, and a valve controlling said port and moved by the piston, whereby when the said port is opened the pressure in the valve-chamber will be reduced momentarily below that in the train-pipe, and air from the latter will thereupon pass to the brake-cylinder.

6. In a triple valve for automatic air-brakes, the combination of

a chamber having a port leading to a brake-cylinder, a passage opening into said chamber and which supplies auxiliary-reservoir air thereto, a piston-chamber and piston, a valve controlling said port and operated by a piston, and a passage from the auxiliary reservoir direct to said piston-chamber and avoiding the chamber first mentioned and which is larger or of greater capacity than the said passage which supplies auxiliary-reservoir air.

7. In valve mechanism for automatic air-brakes, the combination of a piston-chamber, a piston, a valve-chamber having a brake-cylinder port, a passage for supplying auxiliary-reservoir air when applying the brakes, which passage is smaller or of less capacity than said port, a passage to supply train-pipe air when applying the brakes, a valve in the valve-chamber coacting with said port, and controlling the flow of air to a brake-cylinder from both a train-pipe and an auxiliary reservoir, and a passage from the auxiliary reservoir to the said piston-chamber, and which in its course avoids the said valve-chamber.

8. In a triple valve for automatic air-brakes, the combination of a valve-chamber having a port leading to the brake-cylinder, a piston-chamber and piston, a passage from the auxiliary reservoir direct to the piston-chamber and which avoids the said valve-chamber, a passage which is smaller or more restricted than either the said port or the said direct passage to the piston-chamber, this small passage opening into the valve-chamber, and a valve controlling said port and operated by the piston.

9. In a triple valve for automatic air-brakes, the combination of a chamber having a port communicating with the brake-cylinder, a piston-chamber and piston, a passage from the train-pipe to the ported chamber, a partition provided with a passage which is smaller or more restricted than either the said port or the train-pipe passage, said partition serving to partially separate the ported chamber from the said piston-chamber, and a valve moved by said piston and controlling said port, whereby both train-pipe air and auxiliary-reservoir air may pass the same valve-port for an emergency stop.

10. The combination, in valve mechanism for air-brakes, of a piston, valve-chamber having a communication with a brake-cylinder, one from the train-pipe and another through a throttled or more restricted passage from the auxiliary reservoir, a valve to govern the communication leading to the brake-cylinder, 1309 & 1310 a tubular extension of the piston entering the valve-chamber and moving the valve and containing a passage which forms the said communication between the train-pipe and valve-chamber and a check-valve controlling said last-named passage.

11. In valve mechanism for automatic air-brakes, the combination of a main port communicating with a brake-cylinder from both the train-pipe and the auxiliary reservoir, a suitable valve controlling said main port, a graduating-valve which admits air-pressure in small volume to the brake-cylinder, and air-passages coacting with said main port and relatively proportioned as to their capacity to allow both train-pipe air and auxiliary-reservoir air, each at a

different pressure, to pass to said main port when the latter open.

12. In valve mechanism for automatic air-brakes, the combination of a chamber having a main port leading to the brake-cylinder, a reciprocating valve of plug form coacting with said main port and capable of a certain extent of movement without opening the said port, a graduating-valve *h*, fitting loosely in said plug-valve, and a release-valve unconnected with the said main valve and controlling an air-escape port.

In testimony whereof I affix my signature in presence of two witnesses.

GEORGE ALBERT BOYDEN

Witnesses:

CHARLES L. SULLIVAN.

JNO. T. MADDOX.

No. 403142 C.
Westinghouse & Co. p. 1312
Boyd & Co.

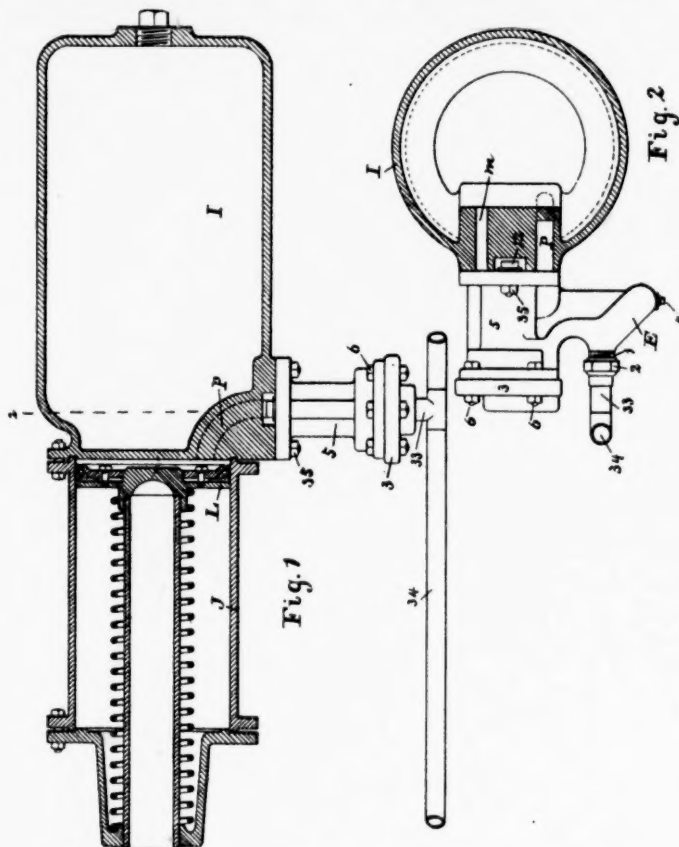
(No Model.)

2 Sheets—Sheet 1.

G. A. BOYDEN.
FLUID PRESSURE BRAKE.

No. 481,135

Patented Aug. 16, 1892.



WITNESSES:

J. P. Davis.
Otto H. Ehlers.

INVENTOR:

Geo. A. Boyden

BY Chas B. Mann
ATTORNEY.

(No Model.)

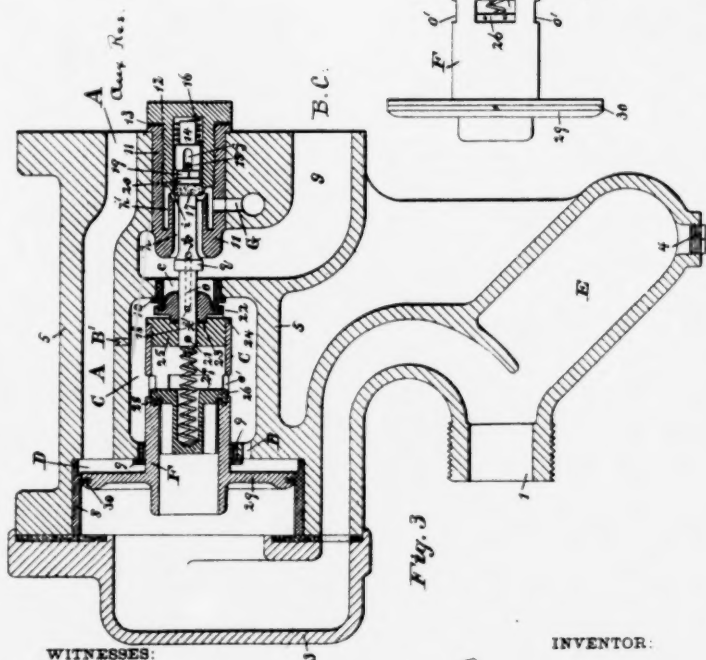
2 Sheets—Sheet 2

G. A. BOYDEN.
FLUID PRESSURE BRAKE.

No. 481,135.

Patented Aug. 16, 1892.

No. 403 r/26.
Westinghouse Co. } h 1314
v.
Boyden Co.



WITNESSES:
J. P. Davis.
Otto H. Ehlers.

INVENTOR:
Geo A. Boyden

BY Chas B. Mann
ATTORNEY.

1315 UNITED STATES PATENT OFFICE.

GEORGE A. BOYDEN, of Baltimore, Maryland, assignor to the Boyden Brake Company of Baltimore City, of Maryland.

Fluid-pressure Brake.

Specification forming part of Letters Patent No. 481,135, dated August 16, 1892. Application filed March 6, 1891. Serial No. 384,012. (No model.)

To all whom it may concern :

Be it known that I, George A. Boyden, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful improvements in fluid-pressure brakes, of which the following is a specification.

This invention relates to the construction of valves for automatic air-brakes, and has for its object to provide for admitting air-pressure to the brake-cylinder from both the train-brake pipe and the auxiliary reservoir, thereby effecting a more powerful and also a quicker application of each brake and at the same time so quickly reducing the air-pressure in the train-brake pipe adjacent to the said valves that all the brakes of a train will be applied at nearly the same time.

Referring to the drawings,

(Here follow diagrams marked pp. 1312 & 1314)

Figure 1 is a section of the auxiliary reservoir and brake-cylinder, with a side view of the valve and train-pipe. Fig. 2 is a cross-section of the reservoir, with a side view of the valve attached thereto, showing the passages by which communication is established between the reservoir and the valve and brake-cylinder. Fig. 3 is a longitudinal section of the valve. Fig. 4 is a side view of the valve-piston and its attached parts.

In my patent of June 26, 1883, No. 280,285, I brought out an improved triple-valve mechanism having a check-valve passage leading from the train-pipe through or around the piston to the main-valve chamber, with a communication to the auxiliary reservoir and a communication to the brake-cylinder, the latter communication being normally covered by the main valve of the triple-valve device and uncovered by the movement thereof, thus utilizing both auxiliary-reservoir air and train pipe air when the brakes are applied. Subsequently George Westinghouse, Jr., for the purpose of utilizing train-pipe air, in addition to auxiliary-reservoir air for applying the brakes in quick action, adopted a check-valved passage leading from the train-pipe around or past the triple valve directly to the brake-cylinder without passing through the main-valve chamber and covered said passage with a valve additional and "auxiliary" to the triple-valve mechanism, said auxiliary valve

performing none of the three ordinary functions of the latter, but adapted and used solely for producing a "quick action" of the brakes in applying for emergency. The United States patent for the Westinghouse invention here referred to is dated March 29, 1887, and numbered 360,070.

In my present invention I use the check-valved feed-passage of my 1883 patent, leading from the train-pipe through the triple-valve piston to the main-valve chamber, and thence both to the auxiliary reservoir and the brake-cylinder for the double purpose of supplying the auxiliary reservoir, and also enabling train-pipe air to be vented directly through the main-valve chamber into the brake-cylinder to aid in applying the brakes for emergency stops, and this is done without interfering with the usual operation or functions of the "triple valve" and also without the aid of the "auxiliary valve," heretofore required for the purpose. It will be seen that the means I have thus provided for introducing train-pipe air into the brake-cylinder for "emergency stops" differs, essentially, from that shown in said patent No. 360,070, and that said means involves a new mode of operation.

The branch pipe 33 from the train-pipe 34 is connected to the valve by its nozzle 1 and union-nut 2, which screws thereon, the intervening joint between being made tight by a washer. The valve-case is provided with a drip-chamber E, extending below to drain the water therefrom and from which it is drawn off by removing the plug 4. The cap 3 is secured to the body 5 by suitable bolts 6 and the joint between is made tight by a washer. The body-piece 5 of the valve is provided with a cylinder D, lined with a brass bushing 8, a large passage A communicating between the auxiliary reservoir and said piston-cylinder a valve-chamber C, having at one end an opening lined with a brass bushing 9, which serves in part as a partition and separates the piston-chamber D from the valve-chamber C. A small passage B opens in the present instance between the piston-chamber D and the valve-chamber C and forms a communication through which air from the auxiliary reservoir is admitted to the valve-chamber C, and vice versa.

1316 At the opposite end of the valve-chamber is a bushing 10, forming a port c, which is closed by the main valve 22. At this end of the body-piece is a passage g, leading to the brake-cylinder, and a bushing 11, having an exhaust-passage G opening to the atmosphere. It is obvious the restricted communication by which auxiliary-reservoir air flows to the valve-chamber may open directly between the auxiliary-reservoir passage A and the valve-chamber, as at B' in dotted lines. However located, this passage is much smaller than the passage A between the piston-cylinder D and the auxiliary reservoir. The piston 29 is provided with a packing-ring 30 and moves in the cylinder D, according to the changes in the preponderance of the pressure. Integral with the piston is the sleeve F, which fits and moves in the bushing 9. A cap 25 is secured to the sleeve F by the screw 21, which passes cross-wise through the cap and also through a stem 18 and has each end resting in the piston-sleeve F.

A bushing 11 is fitted in an opening at the end of the body-piece 5. This bushing has a central passage *h* and an annular passage *h'*. A release-port *i* connects said two passages, and the annular passage has a connection with the exhaust-passage G. A cap 12 fits into the bushing, and a washer 13 makes a tight joint between the cap and bushing. The cap has a central passage, conforming in size to the central passage *h* of the bushing, and is practically a continuation thereof. The release-port *i*, before mentioned, is formed where the inner end of the cap adjoins the annular passage *h'*. In this cap is arranged an abutting piece 14, which has a limited movement by means of a slot *j* and the pin 15. A spring 16 presses against the abutting piece 14 and forms a resistance in graduating to the end of the stem 18 and to the movement of the piston 29 and its attached parts. The release-valve is formed by a leather cup 17, secured to the valve-stem 18 by a screw 19, which extends into the stem, and a washer 20, that binds the said cup. The release-valve is movable like a piston in the central passage *h* of the bushing 11 and cap 12 and opens and closes the release-port *i*. The graduating-valve is formed by the valve-stem 18, having a passage *o*, with an opening *k* at one end, a port *k'* at the other, and with the main valve 22 loose on the said stem 18. The main valve 22 closes the large port *c*, which leads to the brake-cylinder, and this valve seats on the packing-rings 23 and 24. This valve 22 is loose on and is movable lengthwise of the stem 18, which wholly supports it. I term it a "floating" valve because it rides and may move freely on the stem and when unseated from the port *c* is not in contact with any other part. In the piston-sleeve F is arranged in a relation similar to my said 1883 patent the check-valve 26, which is held closed by the spring 27, the seat of the check-valve being formed by the packing-ring 28. The piston-sleeve forms the train-pipe passage and has openings *o'*, which communicate with the valve-chamber C. The partition where the guide-bushing 9 is located isolates or separates the auxiliary-reservoir side of the piston-chamber D from the valve-chamber C, and this makes it possible when fully applying the brakes in an emergency for the piston 29 to be subjected on its auxiliary-reservoir side to a greater air-pressure than that contained in the valve-chamber.

As shown in Fig. 1, the auxiliary reservoir I is attached to the brake-cylinder J, in which moves the piston L. The valve-body 5 is attached to the side of the auxiliary reservoir by the studs and nuts 35, and the large passage A communicates with the auxiliary reservoir I through the passage *m*. Communication between the valve and the brake-cylinder J is established through the curved passage P, connecting with the passage *g* in the valve.

Triple valves heretofore extensively in use, like that patented to George Westinghouse, Jr., October 14, 1879, No. 220,556, have been arranged to effect two grades of brake application by auxiliary-reservoir pressure. The first grade may be called "full pressure," and the second grade, which is partial pressure, is known as "graduation." For effecting these two grades of application a main valve and a graduating-valve have been employed corresponding gener-

ally, though embodied in a different form, with the main and graduating valves 22 and k' . (Here shown.) The graduation-valve $k' o k$ in the stem 18 of the present valve mechanism performs the ordinary functions of such a device and is brought into useful action only in making graduation applications of the brakes. This graduation-valve does not affect the action of the release-valve or the main valve 22, which latter will allow the flow to the brake-cylinder of auxiliary-reservoir air alone, and also allow the flow of both auxiliary-reservoir air and train-pipe air. It will therefore be seen that the presence or absence of the graduation-valve is not essential to the performance by the other parts of all the functions of a triple valve.

The operation of the valve is as follows: To charge the auxiliary reservoir, the air from the train-pipe passes in through the nozzle 1 and moves the valve-piston 29 to the position shown in Fig. 3, where the graduating-valve port k' and the main-valve port c will be closed, and thus all communication with the brake-cylinder cut off. The air then opens the check-valve 26 and passes through the openings o' in the sleeve F to the valve-chamber C, from which it passes through the small passage B into the piston-cylinder D, and thence through the large passage A to the auxiliary reservoir. An equalization of air-pressure will thus be brought about in the
 1317 auxiliary reservoir I, valve-chamber C, and train-pipe, and the check-valve 26 will be seated.

To apply the brakes by graduation, a slight reduction of the pressure in the train-pipe moves the piston 29 and its attached parts until the shoulder q on the stem 18 comes against the main valve 22, (the main valve remaining immovable on its seat, owing to the air-pressure in the valve-chamber C holding it thereon.) This movement closes the release-valve port i and draws the graduating stem 18 through the main valve 22 sufficiently far to expose the graduating-port k' in the valve-stem to the air-pressure in the valve-chamber C. The air then passes from the auxiliary reservoir by way of the large passage A and small passage B into the valve-chamber C, and then through the graduating-port k' passage o , and opening k in the valve-stem and the passage g to the brake-cylinder, where it effects the partial application of the brakes. This operation, which does not open the main-valve port, is due to the fact that the restricted communication B, through which the auxiliary-reservoir air enters the valve-chamber C, is larger than the graduating-port k' , and therefore the pressure in the valve-chamber is kept substantially equal to that in the auxiliary reservoir. This retention of the pressure in the valve-chamber when graduating holds the main valve 22 and the check-valve 26 seated on their respective ports. As the main valve 22 remains immovable on its port at the time the brakes are being applied by the graduation-valve, it serves to arrest the movement of the piston by means of the stop-shoulder q on the stem coming in contact with it. The piston 29 and its attached parts will remain in the same position—to wit, with the stem-shoulder q in contact with the main valve 22—until the pressure has been reduced in the auxiliary reservoir below that in the

train-pipe. The greater train-pipe pressure will then cause the piston 29 to move to the right till the end of the valve-stem 18 comes in contact with the spring-held abutting-piece 14, which retards the movement. When in this last position, the graduating-port k' in the valve-stem 18 is closed by having passed into the main valve 22, and thus prevents any further accumulation of pressure in the brake-cylinder. While in this position the cup-valve 17, which controls the release of the air, has not moved sufficiently far to uncover the release-port i , that leads to the atmosphere, and thereby holds the pressure in the brake-cylinder, which exerts the desired braking force. If it is desired to gradually increase the pressure in the brake-cylinder, the above operation may be repeated. To release the brake, the engineer's valve is moved, and thereby the maximum pressure is restored in the train-pipe, which, acting on the piston 29, overcomes the resistance of the abutting spring 16 and moves the piston and its attached parts to the right to the extreme limit of its movement, as shown in Fig. 3, which causes the release-valve 17 to uncover the release-port i and allow the air to pass from the brake-cylinder back through the passage g , then into the central passage h , around the stem 18, through the port i , and from thence to the annular passage h' in the bushing 11, from which it passes through the passage G to the atmosphere. At the same time that the brakes are released the restoration of the pressure in the train-pipe will recharge the auxiliary reservoir for future use. The brakes may be applied fully in two ways: first, by the auxiliary-reservoir pressure alone, and, second, by the auxiliary-reservoir pressure in conjunction with the train-pipe pressure. The first mode is used when an ordinary gradual stop is required, such as at a station. The second mode is used when an emergency stop is required, such as upon the occurrence of an accident. To apply the brakes fully for an ordinary stop, a limited amount of train-pipe air is continuously discharged from the engineer's valve, which reduces the pressure in the train-pipe and slowly moves the piston 29 to the left and opens the main valve 22 sufficient to practically maintain the same air-pressure on both sides of the said piston. The piston and the said valve will be retained in the position just mentioned, or the piston will slightly vibrate back and forward, causing the valve 22 to repeatedly unseat and seat by the discharge of the auxiliary-reservoir air (through the valve-chamber C to the brake-cylinder) being about equal to the continuous discharge of air from the train-pipe at the engineer's valve. Under these conditions the pressure in the brake-cylinder, valve-chamber C, and auxiliary reservoir will equalize, and thus the ordinary function of the triple valve in applying the brakes fully by the auxiliary-reservoir pressure alone is accomplished. If the train-pipe pressure continues to lower slowly, the piston and its attached parts will be moved their full stroke to the left; but the air from the train-pipe will not pass to the brake-cylinder, because by this continuous but limited discharge of train-pipe pressure the air-pressure in the valve-chamber C will not be suddenly reduced below that in the train-pipe, as in this operation the main valve will not be opened sufficiently to discharge

more air than the passage B supplies. To apply the brakes of a train quickly and with full power for an emergency stop, the engineer's valve will be moved to close communication between the storage-tank on the locomotive and train-pipe and open the latter to the atmosphere and effect a sudden reduction of pressure of from ten to twenty pounds in the train-pipe. The effect of this sudden diminution of pressure in the train-pipe is immediately manifested at the triple-valve mechanism on the first car, causing the valve-piston 29 to be moved by the higher pressure of auxiliary-reservoir air quickly to its full outward position, thus moving the main valve 22 and opening the main port *c*, so that the air-pressure contained in the valve-chamber C may exhaust freely into the brake-cylinder. The supply of air from auxiliary reservoir to the valve-chamber is conducted through the restricted or small passage B. Hence when the main port *c* is fully opened and the air in valve-chamber C escapes through the larger passage thus provided, the pressure in said valve-chamber is quickly reduced below that in the piston-chamber D on the auxiliary-reservoir side, notwithstanding the fact that both the valve-chamber and the piston-chamber on said side receive air from the same source—*i. e.*, the auxiliary reservoir. The exhaustion of pressure from the valve-chamber C or the great reduction of pressure therein following the sudden opening of the main port *c* brings said air pressure below that existing in the train-pipe, whereupon the check-valve 26 will be immediately unseated by said train-pipe pressure, and train-pipe air will then pass directly into the brake-cylinder J, thus effecting the quick application of the brakes and also further reduction of pressure in the train-pipe that will be sufficient to accelerate the action of the valve mechanism on the cars following. The piston 29 will in the meantime be held to its outward position by the relatively higher air-pressure from the auxiliary reservoir, which is delivered through the large passage A, while the transmission of auxiliary-reservoir air to the brake-cylinder is retarded by having to pass through the relatively smaller passage B. Thus a considerable volume of train-pipe air at lower pressure—say fifty to sixty pounds—will flow into the brake-cylinder, notwithstanding the admission of the auxiliary-reservoir air under a higher pressure, because the flow of auxiliary-reservoir air is so retarded by the smaller passage B that an appreciable period of time is required to raise the pressure in the brake-cylinder so that it and that in the auxiliary reservoir will be equal, and it is during this interval and before the pressure in the brake-cylinder is raised to equal that in the train-pipe that the air from the latter is free to enter the brake-cylinder. It will thus be seen that the sudden uncovering of the main port *c*, leading to the brake-cylinder, opens communication both between the train-pipe and brake-cylinder and also between the auxiliary reservoir and the brake-cylinder. As soon as the pressure above the check-valve, caused by the auxiliary-reservoir air plus the pressure of the spring 27, exceeds the pressure exerted by the train-pipe air on the other side the check-valve will close and the further ingress of train-pipe air to the brake-cylinder will

be cut off, while the auxiliary-reservoir air will continue to flow, thus augmenting the pressure in the brake-cylinder. This valve mechanism belongs to the class of air-brake valves known as "triple valves," of which there are numerous examples, differing somewhat in construction and embodying variations and modifications in the form and arrangement of parts; but all of them, however specially constructed, contemplate a valve structure having suitable connections for the train-pipe, the auxiliary reservoir, and the brake-cylinder, and they are provided with passages or ports leading, first, from the train-pipe to the auxiliary reservoir; second, from the said reservoir to the brake-cylinder, and, third, from the brake-cylinder to the atmosphere. Hence the name "triple valves."

An examination of the particular embodiment of the present invention will disclose the fact that it is a triple valve *per se* without auxiliary or supplemental valve devices, and, further, that its conversion into a "quick-action" valve and its greater capacity for action over previous forms of triple valves is due to means here employed for transmitting train-pipe air direct to the brake-cylinder through the triple-valve chamber C and through the port *c* of the triple main valve, and at the same time retarding or restricting the flow of auxiliary-reservoir air to the said main port as compared with the more open or free delivery of train-pipe air to said main port. It will also be seen that a single valve 22, the main valve of the triple valve proper, here performs the office of opening a port *c* to the brake-cylinder, through which port both the train-pipe and the auxiliary-reservoir airs pass in the quick application of the brakes for emergency stops.

In my application for letters patent filed September 30, 1889, serial No. 325,474, I have shown and described a valve for automatic air-brakes of the same type as that which constitutes the subject-matter of the present specification. In my said earlier application the fundamental features of the invention have been claimed. The present specification therefore relates to certain improvements in the construction of said valves.

Having thus described my invention, what I claim as new, and desire to secure by letters patent, is—

1. A triple valve for automatic air-brakes, having, in combination, a port *c*, leading to the brake-cylinder, a main valve 22, which closes and opens said port, a valve to release the air from the brake-cylinder, a piston actuated by air-pressure, and a stem having one end suitably connected with the piston and which passes loosely through the main valve and also through the said port leading to the brake-cylinder and imparts movement to the said release-valve.

2. A triple valve for automatic air-brakes, having, in combination, a port *c*, leading to the brake-cylinder, a main valve 22, which closes and opens said port, a valve to release the air from the brake-cylinder, a piston actuated by air-pressure, a stem having one end suitably connected with the piston and which passes loosely through the main valve and also through the said port leading to the brake-cylinder and imparts movement to the said release-valve, and a stop-shoulder on the said stem between the main valve and release-valve.

1319 & 1320

3. A triple valve for automatic air-brakes, having, in combination a port c, leading to the brake-cylinder, a piston actuated by air pressure, a stem having one end suitably connected with the piston constructed to act as a graduating-valve, a main valve 22, loose on said stem and which rides or floats lengthwise thereof and is wholly supported thereby and opens and closes the said port leading to the brake-cylinder, and a stop-shoulder on the stem to come in contact with the said main valve, whereby when the brakes are being applied by the graduating-valve the main valve remains immovable and the stop-shoulder coming in contact with it arrests the movement of the said piston.

4. A triple valve for automatic air-brakes, having, in combination a passage from the train-pipe, a passage from the auxiliary reservoir which is smaller or more restricted than said train-pipe passage, a main port co-acting with both of said passages and communicating between them and the brake-cylinder, a piston actuated by air pressure, a stem having one end suitably connected with the piston and a valve loose on said stem and which rides or floats lengthwise thereof and is wholly supported thereby and opens and closes the said main port communicating to the brake cylinder.

5. A triple valve for automatic air-brakes, having, in combination a valve to release the air from the brake-cylinder, a piston actuated by air-pressure, a main port c, leading to the brake cylinder and located between the said release-valve and piston, a stem having one end suitably connected with the piston and which passes through said port and imparts movement to the said release-valve, and said stem provided with a passage having a lateral port for the flow of a small volume of air to apply the brakes by graduation, and a main valve 22, which is free to ride or float lengthwise on said stem and opens and closes the said lateral graduation-port and which also opens and closes the main port leading to the brake-cylinder.

6. A triple valve for automatic air-brakes, having, in combination a port communicating with the brake-cylinder from both the auxiliary reservoir and the train-pipe, means for restricting the flow to the said port of auxiliary-reservoir air when applying the brake for an emergency stop as compared with the flow of train-pipe air, a piston actuated by air-pressure, a stem having one end suitably connected with the piston and which is provided with a small passage for the flow of auxiliary-reservoir air to apply the brake by graduation, and a main valve 22, which rides or floats loosely on said stem and is wholly supported thereby and opens and closes the said port communicating with the brake-cylinder and also controls the said small graduation-passage.

In testimony whereof I affix my signature in the presence of two witnesses.

GEORGE A. BOYDEN.

Witnesses:

JNO. T. MADDOX.

F. P. DAVIS.

1331

UNITED STATES PATENT OFFICE.

GEORGE A. BOYDEN, of Baltimore, Maryland, assignor to the Boyden Brake Company of Baltimore City, of Maryland.

Valve for Automatic Air-brakes.

Specification forming part of Letters Patent No. 481,136, dated August 16, 1892. Application filed February 12, 1892. Serial No. 421,237. (No model.)

To all whom it may concern:

Be it known that I, George A. Boyden, a citizen of the United States, residing at Baltimore, in the State of Maryland, have invented certain new and useful improvements in valves for automatic air-brakes, of which the following is a specification.

This invention relates to a new and improved valve for automatic air-brakes of that class which are called "triple valves." One object of the invention is to provide for admitting air-pressure to the brake-cylinder from both the train-pipe and the auxiliary reservoir by the ordinary slide-valve of the triple valve to produce a quick application of the brakes, and thereby avoid employing an auxiliary valve.

Another object is to provide triple valves which employ slide-valves with new and improved means for graduating without the complication of additional movable parts to the slide-valve and piston, which said means shall be controlled by slight variations of pressure in the train-pipe, so that any desired degree of brake-pressure may be applied to the wheels of the cars.

Since the air-brake triple valve proper has been developed to the slide-valve form, as shown in United States patent to Westinghouse, No. 168,359, dated October 6, 1875, two additional or "auxiliary" valves have been arranged to co-operate with the said triple valve to perform additional functions in braking—to wit, that of "graduating" the brakes—a function that is illustrated in United States patent to Westinghouse, No. 220,556, dated October 14, 1879, and that of "quick action," which is to apply the brakes with greater rapidity and power by partially exhausting the train-pipe of air and discharging said air, together with auxiliary-reservoir air, into the brake-cylinders, a function that is illustrated in United States patent to Westinghouse, No. 360,070, dated March 29, 1887.

Heretofore in triple valves which employ slide-valves where the endeavor has been made to provide for quick action in emergency stop the auxiliary-reservoir air alone has passed to the brake-cylinder by the opening of the slide-valve, while the train-pipe air has passed to said cylinder by a different valve—that is, the auxiliary valve last referred to.

The first part of my present invention consists, broadly, in the combination, with a triple valve having a piston and slide-valve which is moved one way by auxiliary-reservoir-air pressure, of

means whereby both train-pipe air and auxiliary-reservoir air may be admitted by the same slide-valve to the brake-cylinder for applying the brakes. By this part of my invention the air from the train-pipe may be admitted directly to the brake-cylinder without interfering with the usual operation or functions of the triple valve, and also without the aid of the auxiliary valve heretofore required for the purpose. My invention enables the triple valve alone to produce what is called "quick action" in emergency applications.

The second part of my invention consists in the combination, with a slide-valve which is operated by the movement of a piston, of a passage for auxiliary-reservoir air to preliminarily apply the brakes gradually or partially with any degree of pressure, the inlet to which passage is controlled by the said piston and the exit from the passage is controlled by the slide-valve. By this part of my invention the "graduation" or partial application of the brakes may be effected without the use of an auxiliary valve, and also without liability when closing the graduating-passage which admits auxiliary-reservoir air to the brake-cylinder to move the slide-valve to the "release position," where the brake-cylinder air will exhaust to the atmosphere, and thus unintentionally release the brakes at a time when it is desired to keep them applied.

The invention is illustrated in the accompanying drawings.

(Here follow diagrams marked pp. 1322, 1324, 1326, 1328 & 1330.)

Figure 1 shows an auxiliary reservoir and brake-cylinder in section and a side view of my improved valve and illustrates one way of attaching the said valve. Fig. 2 is a longitudinal section of the improved valve on the line 2 2, showing all the parts, the slide-valve being in the release position. Fig. 3 is a view of the valve-case at that end which is to be secured to the auxiliary reservoir.

Fig. 4 is a longitudinal section of the valve-case on the line 1332 4 4, which is transverse to that on which Fig. 2 is taken and shows the slide-valve seat. Fig. 5 is a cross-section of the valve-case on the line 5 5. Figs. 6, 7, and 8 are views of the slide-valve. Fig. 9 is a view of the piston, the parts which are rigidly connected with it, and the slide-valve, these composing all the parts which are removable from the body of the case for inspection or cleaning. Fig. 10 is an end view of the partition, slide-valve, and piston. Fig. 11 is a section of the complete valve, showing the piston, slide-valve, and check-valve in the emergency-stop position and while the train-pipe air is flowing to the brake-cylinder. Fig. 12 shows a modification in the structural features of the valve-case and in the organization of the parts, but which employs a slide-valve, as in Fig. 2, and has the same mode of operation as the structure there shown. Fig. 13 shows a cross-section of the valve-chamber seen in Fig. 12 on the line 13 13.

The valve-case 5 is to be connected with the auxiliary reservoir or brake-cylinder, as desired, and secured at any suitable place, so that the passages A to the piston-chamber will communicate with

(No Model.)

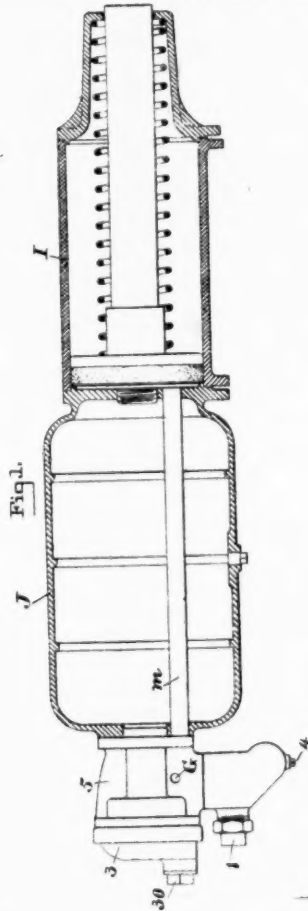
5 Sheets—Sheet 1.

G. A. BOYDEN.
VALVE FOR AUTOMATIC AIR BRAKES.

No. 481,136.

Patented Aug. 16, 1892.

No 403 & 426.
Westinghouse Co. 1/13/92
Boyd Co.

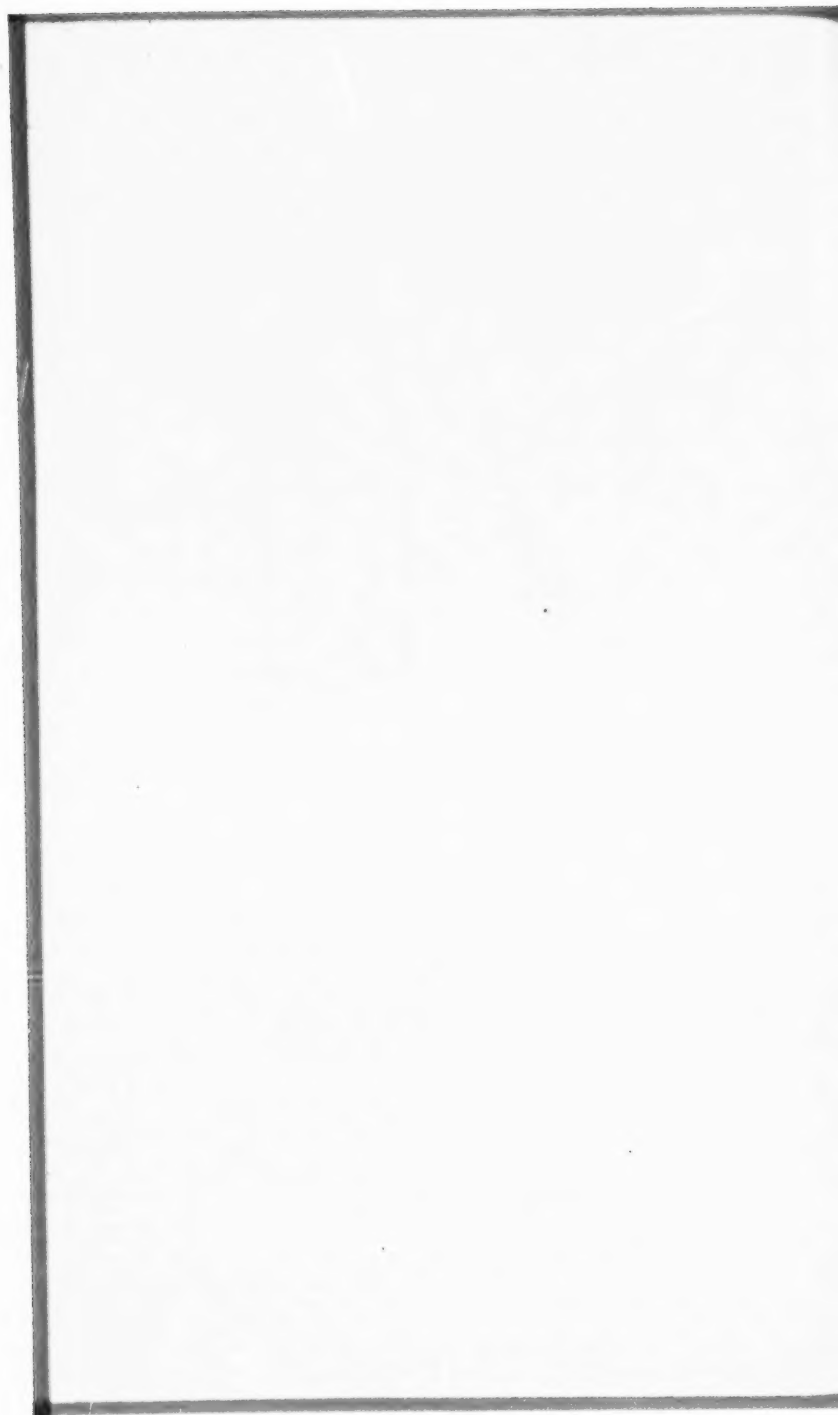


WITNESSES

J. P. Davis.
A. O. Babendrius.

INVENTOR

G. A. Boyden
By Chas B. Mann
Atty.



No. 403 1426
Worthington & Co } *p 1324*
Boyd & Co

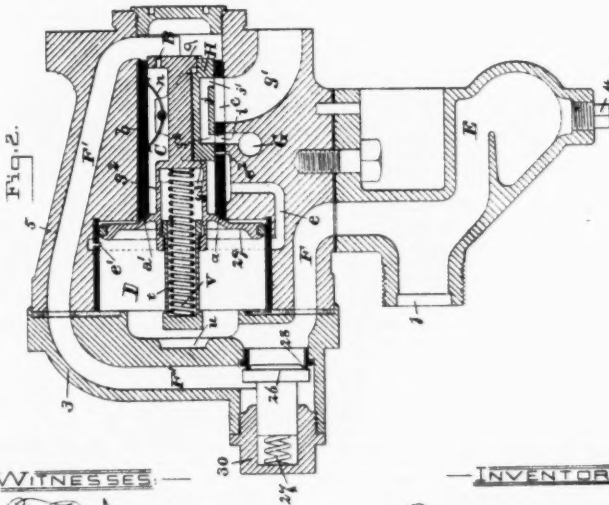
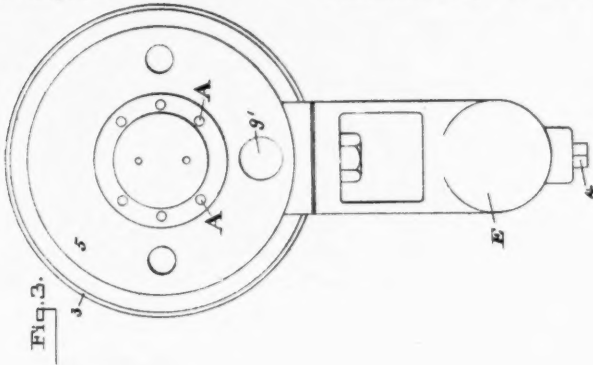
(No Model.)

5 Sheets—Sheet 2.

G. A. BOYDEN.
 VALVE FOR AUTOMATIC AIR BRAKES.

No. 481,136.

Patented Aug. 16, 1892.



—WITNESSES—

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A. O. Fabendruer.

—INVENTOR—

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 By *Chas B. Mann*
Atty.



No 481,136 }
Westinghouse }
Boyle }

(No Model.)

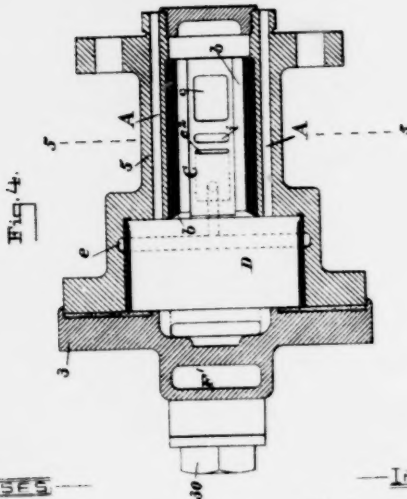
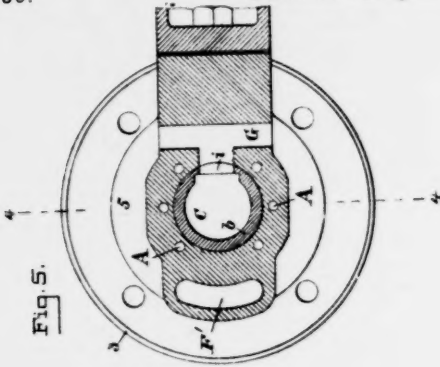
5 Sheets—Sheet 3.

G. A. BOYDEN.

VALVE FOR AUTOMATIC AIR BRAKES.

No. 481,136.

Patented Aug. 16, 1892.



WITNESSES

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No. 403,4426.
Westinghouse & Co.
Boyd & Co. } #1378

(No Model.)

5 Sheets—Sheet 4.

G. A. BOYDEN.
 VALVE FOR AUTOMATIC AIR BRAKES.

No. 481,136.

Patented Aug. 16, 1892.

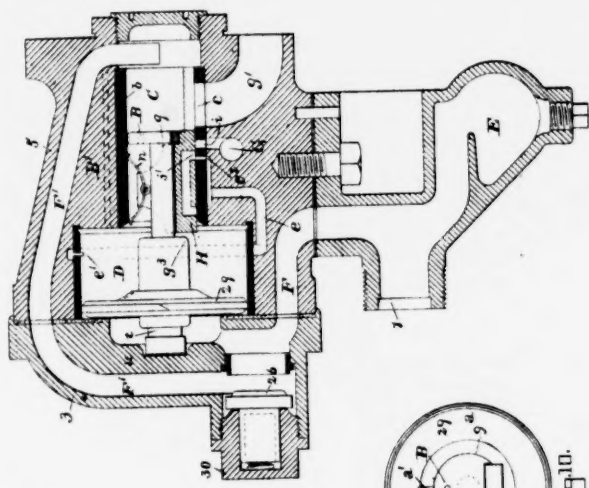


Fig. 11.

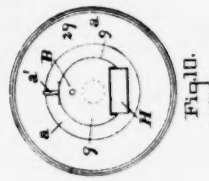


Fig. 10.



Fig. 7.

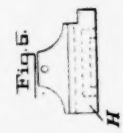


Fig. 5.

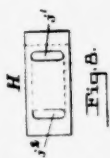


Fig. 8.

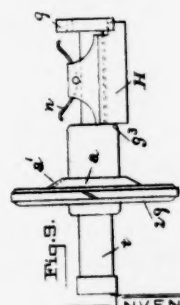


Fig. 9.

WITNESSES

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*Nos. 403 & 426
Westinghouse Co. } p. 1330.
Dryden Co.*

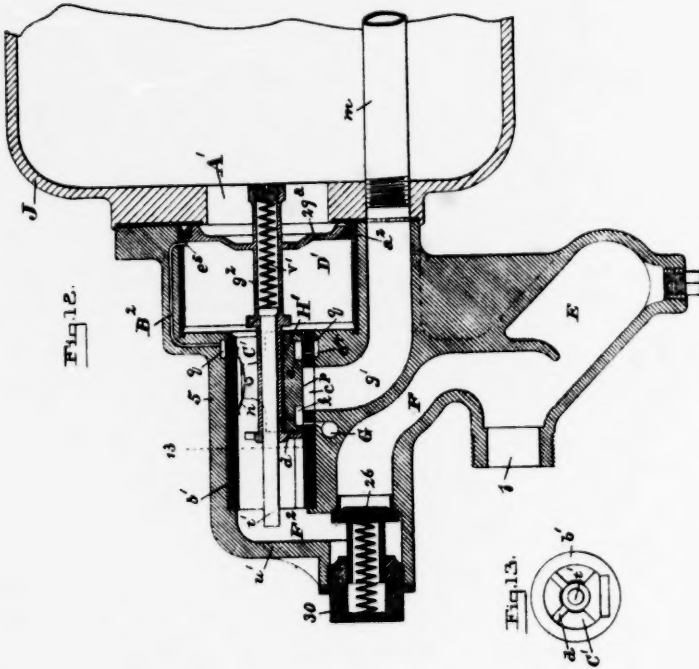
(No Model.)

5 Sheets—Sheet 5.

G. A. BOYDEN.
VALVE FOR AUTOMATIC AIR BRAKES.

No. 481,136.

Patented Aug. 16, 1892.



— WITNESSES —
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said reservoir and the passage g' from the valve-chamber will communicate with the brake-cylinder. The nozzle 1 is to be connected with the train-pipe, the exhaust-passage G opens to the atmosphere, and the port i in the valve-chamber is the inner end of this exhaust-passage. The valve-case is provided with an ordinary drip-chamber E to receive the water of condensation, and the water may be drawn therefrom by removing a plug 4. The piston-chamber D, valve-chamber C, piston 29 and attached stem g^2 , the slide-valve H, and spring n , which holds the said valve to its seat, are all relatively arranged substantially like those parts in triple valves heretofore made.

The first part of my invention will now be described.

Referring to the drawings Figs. 2 to 9, one side of the piston 29 is provided with a conical projection or face a , which stops against the end of the bushing b of the valve-chamber C. Extending from this side of the piston is the stem g^2 , which projects into the valve-chamber and moves the slide-valve H. A passage F leads from the train-pipe nozzle to the piston 29, and a continuation F' of this passage leads around the piston-chamber D to the far or right-hand end of the said bushing b . A check-valve 26 is located at some suitable point in this passage and a spring 27 holds it normally to its seat 28. A cap-nut 30 serves as a guide for the stem of the check-valve and also confines it. By removing the cap-nut the check-valve may be withdrawn. The piston-stem g^2 carries a head or partition 9, which fits snugly and moves in the valve-chamber bushing b . In Figs. 2, 8, 9, and 10 this partition is shown located on the end of the stem and acts on the end of the slide-valve when the piston moves outward or to the left. When the piston has completed its full stroke to the left—the emergency-stop position, (see Fig. 10.)—the brake-cylinder port c is wide open and the partition 9 serves to retard or restrict the auxiliary-reservoir air in its transmission to the said port. At the moment the brakes are being applied for an emergency stop the partition has the effect to confine on the auxiliary-reservoir side of the piston a greater pressure than that of the air passing through the brake-cylinder port, as herein-after explained. A restricted or small passage B through the partition 9 serves as an air communication between opposite sides thereof. A feeding-groove a' is formed on the conical face of the piston 29. Passages A are formed in the case around the valve-chamber and constitute a direct communication between the auxiliary reservoir and the piston-chamber D and without passing through the valve-chamber C. In the present instance six passages A are shown, the combined area or capacity of which affords an ample supply of auxiliary-reservoir air for emergency applications. If desired, the number of these passages may be varied. One passage will serve the purpose as well if it is large enough. The cap 3 is secured to the valve-body 5 by suitable bolts. By taking off this cap all the movable parts of the valve, including those which produce quick action, may be withdrawn for inspection or repair. The communication between the train-pipe nozzle 1 and the auxiliary reservoir for charging the same with compressed air is

by way of the passages F F', restricted passage B, valve-chamber C, groove a' , piston-chamber D, and the passages A. Communication between the train-pipe nozzle 1 and the brake-cylinder direct to produce quick action in emergency stops is by way of the passage F F', slide-valve port c , and passage g' . Communication between the auxiliary reservoir and brake-cylinder for ordinary full application of the brakes, also for quick action, (not including graduating however,) is by way of the passages A, piston-chamber D, valve-chamber C, restricted passage B, slide-valve port c , and passage g' . Communication between the brake-cylinder and atmosphere to release the brakes is by way of the passage g' , slide-valve port c , the cavity j in the slide-valve, the port i in the seat of the slide-valve, and the exhaust-passage G.

It will be seen by the foregoing that a novel feature of this part of my invention is that one and the same slide-valve H here serves three purposes, to wit: First, quick action in applying the brakes for emergency stops by the passage of train-pipe air to the brake-cylinder in conjunction with auxiliary-reservoir air; second, ordinary full application of the brakes by the passage of auxiliary-reservoir air alone to the brake-cylinder, and, third, the release of the brakes.

The second part of the invention—to wit, the improved means for gradually applying the brakes—will now be described.

1333 A passage e to admit auxiliary-reservoir air to produce graduated application of the brakes is in the valve-case and leads from the piston-chamber D to the seat of the slide-valve where its exit-port e^2 opens through the bushing b to said seat. The slide-valve H is provided with a cavity j , and its face has two openings in the form of cross-slots $j' j^2$, one opening being at each end of said cavity, which serve to complete the communication between the exit-port of said graduating-passage and the slide-valve port c , leading to the brake-cylinder. The piston 29 opens and closes the inlet-port e' of the graduating-passage, so that auxiliary-reservoir air may enter the said passage and flow to the brake-cylinder as soon as the opening j^2 of the slide-valve cavity registers with the exit-port e^2 , and thereby establishes communication between the said passage e and the main port c . The passage from the auxiliary reservoir to the brake-cylinder for graduating is as follows: by way of the passage A, piston-chamber D, passage e , cavity j in the slide-valve, and passage g' . The piston 29 is provided on the train-pipe side with a yielding stem or knob t , which comes in contact with a plate u to check or retard the movement of the piston when graduating. The knob-stem t fits telescopically through the piston and into its stem g^2 , and a spiral spring v serves to keep the knob-stem projected with a certain degree of tension.

The operation of my improved valve is as follows: To charge the auxiliary reservoir, the air from the train-pipe entering at the nozzle 1 passes through the passage F to the piston 29 and moves it to the position shown in Fig. 2, where the release-port is open. The air continuing, opens the check-valve 26 to the passage F' and passes to the partition 9, then through the small passage B to the valve

chamber C, through groove *a'* to the piston-chamber D, and then through the passages A to the auxiliary reservoir. The brakes may be applied fully in two ways: first, by the auxiliary-reservoir pressure alone, and, second, by the auxiliary-reservoir pressure in conjunction with the train-pipe pressure. The first mode may be used when an ordinary gradual stop is required, such as at a station. The second mode produces quick action and is used when an emergency stop is required, such as upon the occurrence of an accident. To apply the brakes fully by auxiliary-reservoir-air pressure alone, the engineer's valve is turned to gradually and continuously discharge air from the train-pipe. This particular manner of discharging air at the engineer's valve will slowly move the piston 29 and slide-valve H until they reach their full stroke to the left and open port *c*; but in making this slow movement the air from the train-pipe will not pass to the brake-cylinder, because there will be time sufficient for auxiliary-reservoir air to pass the restricted passage B and accumulate in the passage *g'* and in the brake-cylinder and by accumulating there prevent the pressure in the valve-chamber on the right-hand side of the partition and in the passage F' from becoming reduced to such degree as will allow the diminishing train-pipe pressure to unseat the check-valve 26, and thereby prevent the passage of the train-pipe air to the brake-cylinder. Thus it will be seen that a gradual and continuous reduction of train-pipe pressure at the engineer's valve, as stated, will afford time for the air-pressure, which has been disturbed or slightly unbalanced in the several chambers and passages of the valve-case, to become readjusted and equalized and thereby prevent such a diminution of pressure on the valve-chamber side of the check-valve 26 as will cause the latter to unseat. In this way the parts of the valve device which are comprised in what I have termed the "first part" of this invention accomplish one of the ordinary functions of triple valves in applying the brakes fully by auxiliary-reservoir-air pressure alone. To apply the brakes fully by quick action for an emergency stop, the train-pipe pressure is suddenly reduced by discharging at the engineer's valve, say, about twenty pounds, which quickly moves the piston 29 and its attached parts their full stroke to the left. This will move the slide-valve H and open the port *c* and close the release-port *i*. By thus suddenly and fully opening the main port *c* a passage is opened from the train-pipe direct to the brake-cylinder, through which air from the train-pipe will pass. This passage is as follows: From the nozzle 1 through the passage F, the check-valve 26, and passage F', and as the slide-valve H has been quickly moved to its full open position the condition of pressure will be favorable, as hereinafter explained, and the air will pass through this valve-port *c* directly from the train-pipe to the brake-cylinder. This operation of the valve is due to the coaction of three momentary differential pressures immediately after the piston 29 has suddenly moved its full stroke to the left. These pressures approximately are seventy pounds from the auxiliary reservoir acting on the piston 29 and holding it to the extreme end of its stroke; fifty pounds in the train-pipe and at op-

posite side of piston, due to the twenty pounds reduction by the aforesaid discharge at the engineer's valve, and, say, five pounds in the valve-chamber (see Fig. 11) on the right-hand side of the partition in the passage F' and on one side of the check-valve 26, due to the sudden air-discharge therefrom through the wide-open port *c* and to the fact that the auxiliary-reservoir-air supply thereto is restricted through the small passage B. In this operation the fifty pounds pressure on the train-pipe side of the check-valve unseats the latter and passes through the passage F', the open port *c*, and passage *g'* into the brake-cylinder, thereby performing two
 1334 functions in quick action—to wit, partially emptying the train-pipe, which quickens the action of the triple valve on the brakes of the following car, and partially charging the brake-cylinder with the train-pipe air, which augments the pressure applied to the wheels of the car. After the air-pressures in the train-pipe and brake-cylinder have equalized auxiliary-reservoir air will continue to pass through the said open port *c* to the brake-cylinder, coming by way of the passages A, piston-chamber D, valve-chamber C, and restricted passage B, until there is an equalization of air-pressure in both said reservoir and cylinder. It will thus be seen that the piston which actuates the slide-valve is moved in one direction by auxiliary-reservoir pressure and that air may be passed through the said slide-valve port *c* to the brake-cylinder from both the train-pipe and the auxiliary reservoir to produce quick action for an emergency application of the brakes, and thereby I avoid the employment of an auxiliary valve. The quick-action function does not follow when the port *c* leading to the brake-cylinder is opened slowly and gradually, because then the pressure adjoining the partition 9 on the right-hand side is not reduced materially below the train-pipe pressure. On the other hand, the quick action will follow when said port *c* is opened suddenly and fully, because then the pressure at said location will be reduced sufficiently below the train-pipe pressure for the latter to unseat the check-valve and pass through the right-hand end of the triple-valve chamber to the brake-cylinder. The sudden movement of the slide-valve uncovers the main port *c*, leading to the brake-cylinder; but the flow of the higher-pressure air from the auxiliary reservoir into the brake-cylinder is retarded by being compelled to traverse a relatively small passage (in the present instance at the partition) while the flow of the lower-pressure train-pipe air into the brake-cylinder is facilitated by permitting it to traverse a much larger passage. Therefore the same valve-port *c* allows a considerable volume of train-pipe air to flow into the brake-cylinder, notwithstanding the admission through the same port at the same time of the auxiliary-reservoir air under a higher pressure. To release the brakes, a sufficient amount of air is admitted from the main reservoir, which is on the locomotive, to the train-pipe to overcome the resistance of the auxiliary-reservoir pressure and the friction of the slide-valve H and move the piston 29 and said valve toward the right hand to the position shown in Fig. 2, and thereby establish communication between the brake-cylinder and atmosphere by way of the passage

g' , cavity j , release-port i , and exhaust G. In addition to the said quick-action result obtained by the construction and combination of parts comprising the first part of my invention another useful result or advantage is gained, to wit: Should the piston and slide-valve "stick" by reason of the accumulation of dirt or of gum formed by the oil and fail to move forward when compressed air is first applied to the brake-pipe before the train starts out, then under such circumstances the brakes would be applied by the train-pipe air passing directly to the brake-cylinder, and thereby indicate to the trainmen the defective condition of the brakes. To partially apply the brakes by graduation, either to check the speed of the train or to gradually stop, the train-pipe pressure is reduced slightly but sufficiently to move the piston and slide-valve H to a position that will put the second opening j^2 of the cavity of the valve in connection with the exit-port e^2 of the graduating-passage and cause the piston to open the inlet-port e' of said passage to the auxiliary-reservoir air. The train-pipe pressure must not be reduced enough to enable the greater auxiliary reservoir pressure acting on the piston to overcome the tension of the spring v . This movement of the piston and slide-valve to the left allows auxiliary-reservoir air to continue passing through the graduating-passage e to the brake-cylinder until the pressure on the auxiliary-reservoir side of the piston has been reduced below that which is on its train-pipe side, whereupon the train-pipe pressure will move the piston 29 (but not the slide-valve) partly back to the right until the piston-ring packing closes the inlet-port e' , which by cutting off the flow of auxiliary-reservoir air will so retard the back movement of the piston that the shoulder g^3 of the stem will abut the slide-valve easily. There is sufficient play between the shoulder g^3 and the partition 9 to permit a movement of the piston independent of any movement of the slide-valve H. When the piston-shoulder g^3 abuts easily, as stated, against the end of the slide-valve, the resistance of the latter will stop the piston with its packing-ring over the said inlet-port e' for the time being and prevent any more air passing through the graduating passage e . An advantage resulting from this graduating operation is that when enough air has been entered into the brake-cylinder to effect the desired partial application of the brakes the flow of air through the graduating-passage e is cut off by the piston packing-ring, which prevents the slide-valve being abutted as severely as in devices heretofore employed. Consequently in thus first cutting off the said air-flow there is no liability to move the slide-valve to the release position and unintentionally release the brakes. Thus the graduation is effected by the slide-valve and without the use of an auxiliary valve. The restricted passage B for the supply of auxiliary-reservoir air when applying the brakes for emergency stops is shown in Figs. 2 and 10, for the purpose of clear illustration, as a small hole through the partition 9; but a special hole or passage is not necessary, as the partition 9 may fit the bushing b loosely enough to leave a small space between the rim 9^a of the partition and the wall of the bushing. Such looseness of fit or the space formed thereby may constitute

the restricted passage, and I have used valves constructed in this manner. The restricted passage may also be formed as a distinct channel in the case, as at B' in Fig. 11 or as at B^2 in 12. The partition may be located differently from what is shown in Figs. 2 and 11. It is obvious it may be anywhere on the stem g^2 , so that it is not withdrawn from the bushing when the piston completes its stroke to the left. It may also be stated that the piston itself may under certain conditions be made to serve as a partition. This is illustrated in Fig. 12.

Fig. 12 illustrates a modification in the construction and arrangement of the parts of a valve embodying my invention. This form of valve, although differently organized from that shown in Figs. 2 to 11, inclusive, has the same parts or their equivalents and has the same mode of operation and produces the same result. The valve shown in Fig. 12 differs from that shown in the other figures chiefly in that the slide-valve of Fig. 12 is located on the train-pipe side of the actuating piston, whereas in the other figures it is located on the auxiliary-reservoir side of said piston. Referring to Fig. 12, the valve case 5 is connected with the auxiliary reservoir J and a communication A' opens at one end of said reservoir direct to one side of the piston 29^a and without passing through the valve-chamber C' . The passage g' leads from the valve-chamber to the brake-cylinder I through a pipe m . The nozzle 1 connects with the train-pipe, the exhaust-passage G opens to the atmosphere, and the port i through the valve-seat connects with said exhaust-passage. The piston 29^a , stem g^2 , head d , slide-valve $11'$, and spring u are all substantially like the same parts in Fig. 2. The check-valve 26 is located in the train-pipe passage F, as in the other figures. The relative positions of the piston and slide-valve in the valve-case are reversed in Fig. 12 from what they are in Fig. 2, and a feed-groove a^2 is in the bushing of the piston-chamber D' . The piston 29^a in this modification serves the same functions as the piston 29 in Fig. 2; but it here serves also a function ascribed to the partition 9 in Fig. 2, namely: At the moment when the brakes are being applied for an emergency stop the piston has the effect to confine on its auxiliary-reservoir side a greater pressure than that of the air passing through the brake-cylinder port c . This last function results from the location of the piston on the auxiliary-reservoir side of the slide-valve and the combination therewith of an ample or large passage $F F^2$ for train-pipe air and a restricted or small passage B^2 for the supply of auxiliary-reservoir air when applying the brakes for emergency stops. This restricted passage B^2 has its inlet e^5 in the piston-chamber and its exit in an annular groove q around the valve-chamber. In this instance the passage from the train-pipe nozzle for charging the auxiliary reservoir and to the brake-cylinder to produce quick action in emergency stops is through the valve-chamber C' and past the back of the slide-valve $11'$. The piston-stem g^2 is tubular and on the train-pipe side has a yielding stem t' , which fits and moves telescopically into the piston-stem, and a spiral spring v' keeps the yielding stem normally projected. The end of the yielding stem t' comes in contact with a plate u' and retards the move-

ment of the piston when graduating. The slide-valve I I' in this case has two cavities *k* *o* and a central face *p* between them. One cavity *k* connects the brake-cylinder passage *g'* with the release-port *i* and the other cavity *o* connects with a port *e'* in the slide-valve seat, which port communicates with the restricted passage B² by way of the annular groove *q* in the case, which groove is covered by the bushing *b'*. To charge the auxiliary reservoir, Fig. 13, train-pipe air passes through passage F F², valve-chamber C, piston-chamber D', and feed-groove *a*². To apply the brakes fully by auxiliary-reservoir pressure alone, the piston 29^a moves slowly to the left and then air passes from the auxiliary reservoir J through the port *e*, restricted passage B², annular groove *q*, port *e'*, in the slide-valve seat, and passage *g'* to the brake-cylinder. This will continue until the full power of the auxiliary-reservoir air is exerted in the brake-cylinder. To apply the brakes fully by quick action for an emergency stop, the piston 29^a must be moved quickly to the left, and thus suddenly open the main port *c*. The air pressure in the valve-chamber C' between the piston and the check-valve will at once discharge through the passage *g'* into the brake-cylinder, which will reduce the pressure at said location below the train-pipe pressure. Thereupon the check-valve 26 will unseat and train-pipe air will pass freely to the brake-cylinder by way of the passage F F² back of the slide-valve II' through the port *c* and passage *g'*. At the same time the auxiliary-reservoir air at higher pressure than the said train-pipe air will also pass to the brake-cylinder through the restricted or small passage B², annular groove *q*, port *e'*, port *c*, and passage *g'*. Thus in applying for emergency air passes to the brake-cylinder through the same port from both the train-pipe and the auxiliary reservoir. To release the brakes, the piston 29^a is moved toward the right hand to the position shown in Fig. 12, where the cavity *k* in the slide-valve connects the passage *g'* with the release-port *i*, and thus establishes communication from the brake-cylinder to the atmosphere. To partially apply the brakes by graduation, the piston 29^a will be moved from the position shown in Fig. 12 toward the left far enough to open the inlet-port *e*⁵ to the auxiliary-reservoir air, and also put the cavity *o* of the slide-valve in connection with the port *e'*, and also the passage *g'*, leading to the brake-cylinder. In graduation the piston 29^a is kept in this position but a moment, and then moves toward the right hand and covers the inlet-port *e*⁵, and thereby stops the flow of auxiliary-reservoir air to the brake-cylinder. It will thus be seen the passage B² in this modification serves to transmit auxiliary-reservoir air to the brake-cylinder in a restricted manner when applying for emergency stops, and also to transmit such air when graduating.

It will be seen that no auxiliary valve is employed and that a single slide-valve controls the compressed air in the several actions which the apparatus is designed to perform—to wit, applying the brakes by the full power of auxiliary-reservoir pressure alone, releasing the brakes, applying the brakes on the so-called "quick-action" plan—i. e. by train-pipe pressure in conjunction with auxiliary-reser-

voir pressure—and partially or wholly applying the brakes by graduating. It will also be seen that while I have provided for the said quick-action result to be effected by a single slide-valve alone and without an auxiliary valve, yet this feature of my invention may be worked or employed in connection with graduating devices of different structure from that here shown.

It is to be understood that various of the structural features here shown or described and the form and location of the ports and passages may be changed or varied without departing from my invention.

Having thus described my invention, what I claim as new, and desire to secure by letters patent, is—

1. The combination, in valve mechanism for automatic air-brakes, of a port through which air passes to the brake-cylinder from both the train-pipe and auxiliary reservoir to produce quick action, a port leading to the atmosphere to exhaust the air from the brake-cylinder, a single slide-valve to control the said ports, and a piston which actuates the slide-valve and is moved in one direction by auxiliary-reservoir pressure and in the opposite direction by train-pipe pressure.

2. The combination, in valve mechanism for automatic air-brakes, of a piston actuated in one direction by auxiliary-reservoir pressure and in the opposite direction by train-pipe pressure, and a single slide-valve controlling the passage of air to the brake-cylinder from both the train-pipe and auxiliary reservoir for an emergency application of the brake.

3. The combination, in valve mechanism for automatic air-brakes, of a piston-chamber, a piston, a valve-chamber having a port through which air passes to the brake-cylinder from both the auxiliary reservoir and train-pipe, a slide-valve controlling said port, and a partition which at the time of applying the brakes separates the auxiliary-reservoir-air pressure that is on the said piston from the pressure in that part of the valve-chamber that is adjacent to the said port.

4. The combination, in valve mechanism for automatic air-brakes, of a valve-chamber, a slide-valve therein controlling the exhaust of air from the brake-cylinder to the atmosphere and also the passage of air to the brake-cylinder from both the train-pipe and the auxiliary reservoir, a piston-chamber, and a piston to actuate the said slide-valve and carrying a partition arranged to retard or restrict the auxiliary-reservoir air in its transmission to the port of the said slide-valve.

5. The combination, in valve mechanism for automatic air-brakes, of a port through which air passes from both the auxiliary reservoir and train-pipe to the brake-cylinder, a port leading to the atmosphere, a passage for auxiliary-reservoir air to pass to said brake-cylinder port, a passage having a greater area than the first-mentioned passage to admit train-pipe air to said brake-cylinder port, a slide-valve to control said ports, and a check-valve located in the said train-pipe passage.

6. The combination, in valve mechanism for automatic air-brakes,

piston-chamber, a piston, a valve-chamber having a port leading to the atmosphere and also a port leading to the brake-cylinder, a slide-valve controlling the said ports, a communication for auxiliary-reservoir air direct to one side of the said piston without passing through the valve-chamber, and a restricted communication for auxiliary-reservoir air to pass to said brake-cylinder port.

7. The combination, in valve mechanism for automatic air-brakes, of a valve-port through which air passes to the brake-cylinder from the auxiliary reservoir and direct from the train-pipe, an exhaust-port, a slide-valve to control the said port, a piston, and communications relatively proportioned to produce on the auxiliary-reservoir side of the piston a greater pressure than that of the said train-pipe passing through the brake-cylinder port.

8. The combination, in valve mechanism for automatic air-brakes, of a slide-valve seat having a port which is in communication with the brake-cylinder, a passage through which train-pipe pressure is transmitted to the said brake-cylinder port when applying the brakes for emergency stops, a passage of more restricted capacity than said train-pipe passage and through which auxiliary-reservoir pressure also is transmitted to the said brake-cylinder port when applying the brakes for emergency stops, and a slide-valve resting on said seat and coacting with said port and controlling the passage to the brake-cylinder of both the train-pipe and auxiliary-reservoir pressure, as set forth.

9. The combination, in valve mechanism for automatic air brakes, of a slide-valve, a piston which actuates the said slide-valve, and a graduating-passage for auxiliary-reservoir pressure to preliminarily apply the brakes, the exit from which passage is controlled by the said slide-valve and the inlet thereto by the said piston and which passage admits auxiliary-reservoir pressure to the brake-cylinder when open at both of said controlled places.

1037 & 1338 10. The combination, in valve mechanism for automatic air-brakes, of a slide-valve seat having a port which is in communication with the brake-cylinder, a passage leading to the said slide-valve seat and through which auxiliary-reservoir pressure is transmitted for graduating the brakes, a passage through which train-pipe pressure is transmitted to the said brake-cylinder port when applying the brakes for emergency stops, a passage of more restricted capacity than said train-pipe passage and through which auxiliary-reservoir pressure also is transmitted to the said brake-cylinder port when applying the brakes for emergency stops, and a slide-valve traversing said seat and controlling the air passing through all three of said passages.

11. The combination, in valve mechanism for automatic air-brakes, of a slide-valve seat having a port which is in communication with the brake-cylinder, a passage leading to the said slide-valve seat and through which auxiliary-reservoir pressure is transmitted for graduating the brakes, a passage through which train-pipe pressure is transmitted to the said brake-cylinder port when applying the brakes for emergency stops, and a single slide-valve traversing

ing the said valve-seat and controlling the said passages, for the purpose set forth.

12. The combination, in valve mechanism for automatic air-brakes, of a slide valve seat having three ports, the first of which is in communication with the brake-cylinder and the second with the atmosphere, a graduating passage leading to the third valve-seat port and through which auxiliary-reservoir air is transmitted to preliminarily apply the brakes, a single slide-valve traversing the said seat and controlling the graduating or preliminary application of the brakes and the release of the same, and a piston to actuate the said slide-valve and having a limited movement independent thereof.

In testimony whereof I affix my signature in the presence of two witnesses.

GEORGE A. BOYDEN.

Witnesses:

FRANK P. DAVIS.
JNO. T. MADDOX.

1339 *Complainants' Testimony in Reply, under Order of Court Made March 29th, 1894.*

United States Circuit Court, District of Maryland.

GEORGE WESTINGHOUSE, JR., <i>et al.</i>	} In Equity. No. 321.
<i>vs.</i>	
BOYDEN POWER BRAKE Co. <i>et al.</i>	

Messrs. Barton & Wilmer, solicitors for defendants, Baltimore, Md.

GENTLEMEN: Please take notice that testimony on behalf of complainants, in reply to defendants' surrebuttal testimony, will be taken at the offices of George H. Christy, No. 110 Diamond street, Pittsburgh, Pa., commencing on Tuesday, May 8th, 1894, at 10.30 o'clock a. m. The testimony will be taken under the 67th rule in equity, and under the order of the court in this behalf.

J. SNOWDEN BELL,
Of Counsel for Complainants.

Pittsburgh, April 27th, 1894.

Due service admitted this 28th day of April, A. D. 1894.

SKIPWITH WILMER,
Solicitor for Defendants.

1340 United States Circuit Court, District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WESTINGHOUSE
AIR BRAKE COMPANY

VS.

BOYDEN POWER BRAKE COMPANY; CHARLES A. BOY-
DEN, President; Charles B. Mann, Secretary, and
William Whitridge, Treasurer.

In Equity.
No. 321.

Depositions of witnesses and other evidence in reply on behalf of complainants in the above-entitled cause, taken under the 67th rule in equity and under the order of the court made March 29th, 1894, pursuant to the foregoing notice, before F. E. Gaither, notary public, as special examiner, at the offices of George H. Christy, Esq., Bakewell law building, Pittsburgh, Pa., commencing on Tuesday, May 8th, 1894, at 10.30 a. m.

Present: *J. Snowden Bell*, Esq., of counsel for complainants;
Charles B. Mann, Esq., on behalf of defendants.

H. H. WESTINGHOUSE, being recalled in reply, deposes and says, in answer to interrogatories propounded to him by *J. Snowden Bell*, Esq., of counsel for complainants, as follows, to wit:

887 Q. Are you the same H. H. Westinghouse who heretofore testified in this cause?

A. I am.

888 Q. Were you present at the works of the Boyden Brake
1341 Company, Biddle and Chester streets, Baltimore, Md., on
April 12th, 1894, during the making of experiments by Mr.
George A. Boyden, with valve devices alleged to have been con-
structed in accordance with patent No. 217,838?

A. I was.

889 Q. Did you upon that occasion examine said valve devices,
or either of them, and observe the experiments with sufficient atten-
tion to understand them?

A. I did.

890 Q. Have you read the testimony of defendants' witnesses, G.
A. Boyden and L. J. Gwin, commencing April 4th, 1894, relatively
to valve devices alleged to have been made in accordance with
patent No. 217,838, and experiments made with said valve devices,
and their testimony as to the same subjects-matter given April 13th,
1894?

A. I have.

891 Q. In his answer to Q. 248, Mr. Boyden, referring to the valve
devices, to which and to experiments with which the testimony of
himself and Mr. Gwin, specified in the last preceding question,
relates, says:

"I made the devices in strict accordance with the patent 217,838,
in order to shut off cavil as to their being made like the devices
shown and described in the said patent."

Please state whether or not you found these valve devices to be
"in strict accordance with the patent 217,838," and if not, in what

particulars you found that the instructions of said patent had been deviated from?

A. I did not find the devices made by Mr. Boyden to be in strict accordance with the instructions of patent 217,838, but, on the contrary, there were important and wide variations in those structures.

Referring to Fig. 1 of the illustration of patent 217,838, the area of piston D is about four and a half times the area of passage A. In the valve devices experimented with by Mr. Boyden, the relative areas of the corresponding piston and passage is about eighteen to one. In the figure of the patent previously referred to, the 1342 area of passage C, as compared with the area of piston D, is about one to forty, and corresponding portions of the devices made — Mr. Boyden have relative areas of about one to eighteen. So far as I can see from the specification, or from an examination of the drawing, there seems to be no good reason why the relative proportions of the several parts as indicated in the drawings of patent 217,838 should have been departed from.

I examined one of the structures made by Mr. Boyden, and found that a considerable leakage passage had been provided past the piston D, and I regard the presence of such a leakage passage as a complete departure from the instructions of the patent, and one that would defeat the intended operation of the device.

892 Q. In view of the instructions of the specification of patent 217,838, and the showing of the drawing of said patent, and also in view of the established practice in the construction of appliances relating to fluid-pressure brake apparatus, please state whether a skilled mechanic, working from patent No. 217,838, would be led to fit up the devices of said patent so that the pistons thereof would fit as tightly in their casings as is compatible with proper operation, or whether he would be instructed or warranted in failing to make the pistons fit their casings, and in providing a considerable leakage passage around them?

A. I have been unable to find anything, in the specification or drawings of the patent in question, that would justify any departure from the usual practice of a skilled mechanic, in making a structure from the said drawings and specification. Whenever a piston is shown in a drawing as fitting a cylinder, a skilled mechanic would unquestionably understand that, in the absence of special instructions to the contrary, the piston was to be fitted to the cylinder as tightly as possible consistent with its free movement in the cylinder, and I find no instructions in the specification stating that a leakage 1343 passage is to be provided past the piston D. I do, however, observe that there are instructions which call for a construction that would require the piston D to be as tightly fitted to its cylinder as is consistent with free movement.

The last paragraph of the first page of patent 217,838 states that: "But should the pressure in the front part of the pipe communicating with A be reduced intentionally or by accident, then, the valve E closing the holes in the piston D, that piston is pressed down by the pressure from B, and the valve F is drawn from its seat, leaving

the orifice C open for the escape of air from the hinder portion of the pipe which communicates with B; and by giving the piston D and valve E a sufficient length of stroke or motion, such that it will drop below the shoulder s, an open passageway will be formed for the escape of fluid pressure from the enlarged space or port s^1 to s^2 , and thence out at C."

From this description it will be seen that unless piston D is tightly fitted to its cylinder, a reduction of pressure in passage A would not effect a movement of piston D, or an opening of passage C, because the leakage passage would permit the flow of air from above the piston D, thereby preventing the making of a sufficient difference of pressure on the opposite sides of piston D to cause a downward movement.

The presence of the holes d in the piston D, and of the valve E for closing these holes when pressure is reduced on the under side of piston D, clearly indicates that these passages were necessary to permit air to flow through the train-pipe, for the purpose of charging and releasing brakes.

Neither the holes nor the valve referred to would have been required, if a leakage passage were intended to be provided past the piston D.

The portion of the specification quoted, which states that the giving of the piston D and valve E a sufficient stroke to drop below the shoulder s, so that open passageway will be formed for the escape of fluid pressure from the enlarged space or port s^1 to port s^2 , and thence out at C, clearly indicates that piston D should be tightly fitted and without a leakage passage; otherwise, 1344 there would have been no need for a provision for an extra length of stroke of piston D.

As heretofore stated, I have found nothing in the specification indicating that a leakage passage should be provided past the piston D, and the foregoing reasons that I have given, prove to me that there are the best of reasons why such leakage passage should not exist in the structures shown in patent No. 217,838.

893 Q. State whether or not, you find any matter, either expressed or implied, in the specification or drawings of patent No. 217,838, which would instruct, warrant, or justify the construction of such an appliance as is shown in Defendants' Exhibit- "Working Drawing, Patent 217,838, on Angle Cock" and "Tracing of Working Drawing, Patent 217,838, on Angle Cock."

A. I find absolutely nothing that describes or indicates a construction of the kind referred to.

894 Q. Defendants' witnesses Boyden and Gwin allege, in their testimony, that the pistons D were made "about" one sixty-fourth of an inch smaller than the bore of the casings in which they worked. Mr. Gwin also states that Mr. Boyden instructed him to make the pistons one sixty-fourth of an inch smaller than the bore of the casings, and that the devices were fitted up under his (Gwin's) orders by a machinist and workman. Do you find any testimony on the part of defendants, and if so, where, that these instructions were strictly complied with, or that either Mr. Boyden or Mr. Gwin

actually knows or states the precise width of the leakage space around the pistons of the valve devices?

A. I do not find any testimony of the kind stated.

895 Q. Assuming this leakage space to have been only one sixty-fourth of an inch between the pistons and the casings, what would be its area and what its capacity for permitting the passage of air without allowing the devices to be operative?

A. Assuming the leakage passage to be of the size named, it would have an area of about one-fifteenth of a square inch, and it would require an opening from the train-pipe to atmosphere
1345 with an area in excess of one-fifteenth of a square inch to insure the downward movement of piston D.

The size of opening in train-pipe that is usually employed for making all graduated applications of the brakes, has an area of about one-twentieth of a square inch.

896 Q. What, then, would be the result of adding, as you say was done, in the valve devices experimented with by Mr. Boyden, a leakage passage having an area of about one-fifteenth of a square inch, to the valve device described and shown in patent 217,838?

A. The result of such addition was to destroy the intended operation of the device of patent 217,838, except when an excessive or unusual reduction of pressure was made in the train-pipe.

897 Q. The record shows that Mr. Boyden was requested by complainants' representatives to make other and further experiments with the valve devices which he used, and that he refused to do so. Please explain why you desired these further experiments to be made, and how far they would have assisted in determining the question of the practical utility of the valve devices in an automatic brake system?

A. I requested Mr. Boyden to make an experiment with devices which he was using for the purpose of ascertaining whether an increase of train-pipe pressure, made at a slow rate, would release the brakes.

I consider this to be an important point for determination, as it frequently happens, in practice, that the restoration of train-pipe pressure for the purpose of releasing brakes is made very slowly.

The operation of the device shown in patent 217,838, requires that the flow of air into the train-pipe for the purpose of releasing the brake shall be at a fairly rapid rate, otherwise there would be no effective pressure to overcome the resistance of piston D and cause the closure of passage C. And if such movement and closure

does not take place, the pressure admitted to the train-pipe
1346 will flow directly to the atmosphere, through passage C without effecting the release of the brakes.

Mr. Boyden was also requested to have new pistons made in accordance with drawings and specification of patent No. 217,838, so that the piston D should fit its cylinder tightly. The object of this request was to determine the operation of the device of the patent in question, when a leakage space was not provided around the piston D.

898 Q. Having in mind the alleged purpose of the experiment

made with these valve devices by Mr. Boyden, to what extent do you consider his reasons for refusing to make the further experiments requested, to be well founded?

A. I do not consider the reasons given by Mr. Boyden for refusing to make further tests, as well founded. It was suggested that the releasing test be made by placing the handle of the engineers' valve in what is known as the running position; in this position communication between the main reservoir and the train-pipe is considerably smaller than when the handle of the engineers' valve is placed in full release position. Mr. Boyden stated that releasing of brakes with the handle in the running position would be a more severe test than the standard brakes of today are subjected to in practice. He is mistaken as to this point, as brakes are very frequently released with the handle in running position, and in many instances, special instructions have been issued that the brakes were to be released entirely through the running-position port. It has also been proposed by a railroad officer having charge of the operation of brakes, to modify the engineers' valve so there would be but one port, and that one the running-position port, for the purpose of releasing brakes.

The tests made by the Master Car Builders' committee for the purpose of determining the practical value of different kinds of triple valves, are much more severe and exacting than the one proposed to Mr. Boyden. The port through which the air flows 1347 for releasing brakes in the tests referred to, is many times smaller than the releasing port of the engineers' valve when the handle is in running position. I do not consider the test of releasing brakes with the handle of the engineers' valve in running position as at all exacting; and I would consider a brake apparatus as entirely impracticable and useless for regular service, if it would not release under the conditions stated, particularly when the valves are clean and in perfect condition, as was presumably the case with the devices with which Mr. Boyden made his experiments.

With respect to the request that experiments be made with pistons fitting the cylinders tightly in the devices of patent 217,838, Mr. Boyden stated that he would not make these experiments, because the ones already experimented with were made in accordance with patent 217,838, and for the reason that they worked as the specification of that patent states they should work, and that they produced the result which the devices of patent 217,838 were invented to produce.

I think Mr. Boyden is entirely wrong in the reasons that he gave for refusing this request. The operation of the devices, as shown at the tests in question, was not at all in accordance with the intended operation as described in the patent. By reference to Mr. Boyden's testimony it will be seen that when the handle of the engineers' valve was placed in service position, and air was discharged for the purpose of applying brakes, there was no movement of the piston D or valve F, and consequently no discharge of train-pipe air to the atmosphere. The specification of the patent distinctly states that when the pressure in the front part of the train-

pipe is reduced it will cause movement of the piston D and the opening of passage C, for the purpose of discharging train-pipe air to the atmosphere.

The only manner in which the movement of piston D could be obtained in the experiments, was by placing the handle of the engineers' valve in a full application position, and completely
1348 exhausting the air from the train-pipe. Nothing whatever in the specification of patent 217,838 calls for such a mode of operation, or for modifications in the structure of the patent that would cause the device to operate in the manner shown in the experiments in question.

I have already referred to the deviations from the directions of the patent, in the devices made by Mr. Boyden, and in view of these facts and the results of the tests as I witnessed them I think Mr. Boyden is fully and entirely wrong in stating his reasons for not making the tests as requested.

899 Q. If I understand your last preceding answer correctly, in the use of the valve devices experimented with by Mr. Boyden, a full application of the brakes was effected, without opening the release passages C of said valve devices. Am I right or not?

A. Your understanding of their mode of operation is correct.

900 Q. Is it or not possible to effect a full application, or any application, of the brakes, under the terms of patent 217,838, and using valve devices made in accordance with the instructions of the specification and drawing of said patent, without opening the release passages C of said valve devices?

A. If the valves are constructed in accordance with the drawing and specification of the patent, it would be impossible to get any application of the brakes without the movement of piston D and the opening of the port C.

901 Q. Is it or not the fact that, in the use of the valve devices employed by Mr. Boyden in his experiments, there were two distinctly different applications of the brakes, to wit, one a full application, in which the valve devices alleged to be in accordance with patent 217,838 were not operative, and another and a quicker application, in which they were operative?

A. There were two distinct modes of operation, which you have correctly described.

902 Q. Is the capacity of the two kinds of application of
1349 the brakes mentioned in the last preceding question, specified or provided for in patent 217,838, or possible under the construction of that patent?

A. No.

903 Q. Was the capacity of two kinds of application of the brakes, one by the ordinary appliances, and another and a quicker application by other appliances, known in the art at the date of the patent No. 217,838?

A. So far as I am aware of, it was not.

904 Q. Taking the valve device as you saw it experimented with, as changed and modified by Mr. Boyden in the particulars you have stated, and in view of the results produced by Mr. Boyden, what is

your opinion as to the practical merit or value of said valve device for actual use in controlling freight trains on railroads?

A. I agree with the opinion expressed by Mr. Boyden in answer to X Q. 348, that the device, as he used it, would not be acceptable to railroad officials for practical use.

905 Q. To what extent, if at all, would your opinion be modified if the valve device was constructed in strict accordance with patent No. 217,838, instead of deviating therefrom, as used by Mr. Boyden, in the particulars you have specified?

A. Not in any respect.

906 Q. Mr. Boyden admits, in answer to X Q. 305, that it is the fact that long prior to the institution of this suit, he, himself, recognized the obvious practical inoperativeness of the device of patent 217,838. To what extent do you concur in Mr. Boyden's recognition of the obvious practical inoperativeness of this device?

A. I fully concur with him.

Adjourned to meet on Wednesday, May 9th, 1894, at 10 a. m.

WEDNESDAY, May 9th, 1894.

1350

Met pursuant to adjournment at 10 a. m.

Present: Counsel as before.

Cross-examination by CHARLES B. MANN, Esq., on behalf of defendants:

907 X Q. State whether your testimony given yesterday relative to the operation of the device of patent No. 217,838 is based on theory and reasoning, or on the demonstration of actual tests made by you?

A. My testimony was based upon a careful examination of the specification and drawings of the patent, and upon the experiments that I witnessed that were made by Mr. Boyden.

908 X Q. Then, you have not made and tested valve devices constructed in accordance with patent 217,838?

A. I have made and tested valves made in accordance with patent 217,838.

909 X Q. State whether or not you understand patent 217,838 has for its object to provide valve devices, by use of which the material advantage could be effected of having all the brakes of the train applied or brought into action simultaneously, or as nearly so as possibly?

A. In a general way, I understand the object of the patent in question to be as stated in the question.

910 X Q. In your answer to Q. 891 you state that there are important and wide variations between Fig. 1 of the drawing of patent 217,838, and the valve devices made and tested by Mr. Boyden. You say, in substance, first, that Mr. Boyden's valves have passages A with area relatively smaller than the pistons D, as compared with the said patent drawing; second, that the area of passages C are relatively larger than the area of the pistons D, as compared with said patent drawing, and, third, that the pistons D were made

smaller than the casings to provide a leakage passage. I now ask you if the devices made by Mr. Boyden were substantially like Fig. 1 of the drawings of the patent, with the exception of your three alleged variations?

1351 A. The devices made by Mr. Boyden that I saw had the general form and appearance of the structure shown in Fig. 1 of the patent. I made personal examination of only one of the devices, and it seemed to be made in accordance with the blue print which is one of the defendants' exhibits.

911 X Q. As to the first of the three variations you mention, do you not think that the purpose of Mr. Boyden could have been endeavor to preserve the general proportions of the device as they appear in Fig. 1 of the patent, and at the same time have the passage of a size that would fit the hose coupling on his test-rack?

Objected to as incompetent, it being obviously impossible for the witness to divine what Mr. Boyden's purpose was in deviating from the patent.

Counsel for defendants replies that the question has reference to a variation which the witness has referred to as existing between the valves as made by Mr. Boyden and Fig. 1, as in the patent. The question does not ask the witness if he could divine what Mr. Boyden's purpose was, but simply inquires, if a certain stated purpose could not, in the opinion of the witness, have been the purpose that actuated Mr. Boyden in changing the proportions of the passage A and piston D.

A. It is impossible for me to say what Mr. Boyden's object was in departing from the instructions of the specification and drawing of patent No. 217,838 in the manner that he did.

With reference to the particular variation asked about, I cannot see that making the piston D relatively larger than the passage A as compared with the proportions shown on the drawing of the patent, in any way facilitated or affected the fitting of his device to the hose couplings that he used, for the reason that the
1352 cylinder in which the piston D moves is considerably above the hose coupling and not at all limited by, that portion of the structure which screws into the hose coupling.

912 X Q. As to the second of the three variations you mention, do you not think it quite reasonable that the purpose Mr. Boyden could have in making the escape passage C relatively larger than it is shown in the patent drawing, was on account of the larger-size train-pipe that is now used with air brakes, as compared with the size of the train-pipe that was used in the year 1879, his test-rack being equipped with the larger-size pipe?

A. As previously stated I cannot know what purpose Mr. Boyden had in making the variations in the structure of patent 217,838 that he did make on the devices that I saw tested in his works at Baltimore; it, however, seems entirely unreasonable to me that he should have carried out his experiments with devices essentially differing from the kind described in the patent, having widely varying proportions as compared with those shown in the patent, and testing

these devices upon a rack with a train-pipe of a size that was not known or used in regular air-brake practice at the time of the invention of the device in question, and for nearly eight years subsequent to its issue. The size of train-pipe that was in use at the time the device in patent 217,838 was invented, was three-quarters of an inch in diameter, and each car had a length of about sixty feet; the size of train-pipe that Mr. Boyden used in his test is of inch and a quarter diameter, and each car has a length of about forty feet, and this larger pipe came into use about the year 1887. The reasonableness of the variation referred to that was made by Mr. Boyden, does not appear to me, as the increase of the capacity of the train-pipe was about doubled as compared with what was in general use in 1879, while the increase in the size of opening used in the devices tested by Mr. Boyden, was about in the proportion of ten to one.

913 X Q. As to the third of the variations you mention, 1353 do you not think it quite reasonable that the purpose Mr. Boyden could have in making the pistons D one-sixty-fourth of an inch smaller than the casings in which they moved, was to avoid the liability of the pistons' sticking, due to grit or sediment, of which more or less is usually contained in train-pipes?

A. I regard the presumption stated as entirely unreasonable, because it is not at all likely that the modification described would remedy the supposed objection. I cannot conceive that it is reasonable to make any modification in a structure that will destroy its intended operation, and there are much better methods of overcoming the suggested trouble than the making of a loose-fitting piston.

914 X Q. In the construction of appliances relating to air-brake apparatus, where it is desired to have a piston fit a cylinder so as to prevent leakage, is it not the usual practice to provide the piston with a packing ring?

A. It is the usual practice.

915 X Q. Has the piston D in the drawings of patent 217,838 any packing ring?

A. No.

916 X Q. Is it not a fact that, in the tests you saw Mr. Boyden make in Baltimore on April 12th, 1894, that in the *fifth* test thereof, as testified to by Mr. Boyden, when the engineers' valve was placed in position for an emergency application, all the fifty brakes on the test-rack applied in ten and a half seconds, and the air was discharged from the train-pipe through the passage C of the valve devices of patent No. 217,838?

Objected to as immaterial, it appearing by the testimony of the witness that the experiments made by Mr. Boyden at Baltimore were made with valve devices not in accordance with patent 217,838, and the results of such experiments, therefore, not being material. And further objected to as not proper cross-examination, and as embodying the assumption that the valve devices experimented with *were* in accordance with patent 217,838.

A. The devices tested by Mr. Boyden worked substantially in the manner described in his testimony, with respect to the fifth test.

917 X Q. In the fifth test made by Mr. Boyden, which you saw, the application of the fifty brakes was quickened, was it not, by the discharge of the train-pipe air through the passages C of the valve devices he used?

Objected to as immaterial, for the reason stated in the last preceding objection.

A. It was.

918 X Q. The valves used by Mr. Boyden in the tests made by him, and which in the fifth test caused the brakes to apply quicker by discharging the train-pipe air through the passages C, were the same valves, were they not, which you have criticised because the pistons D fit so loose as to form what you say are considerable leakage passages?

A. Yes.

919 X Q. You say in answer to Q. 892:

"From this description it will be seen that, unless piston D is tightly fitted in its cylinder, a reduction of pressure in passage A would not effect a movement of piston D or an opening of passage C."

In view of the fact that the valves you saw Mr. Boyden test did open to discharge train-pipe air from the passages C, is it not evident that the pistons D of those valves fitted as tight as the patent 217,838 contemplated?

A. They undoubtedly did not fit as tight as the patent contemplated, for the reason that the tests made by Mr. Boyden showed conclusively that a reduction of pressure could be made in passage

1355 A, sufficiently great to set all the fifty brakes with full force, without the movement of piston D. The patent specifically states that, should the pressure in the front part of the pipe communicating with A be reduced intentionally or by accident, the piston D will be pressed down and the valve F withdrawn from its seat.

920 X Q. You say in answer to Q. 892:

"From this description it will be seen that unless piston D is tightly fitted in its cylinder, a reduction of pressure in passages A would not effect the movement of piston D or an opening of passage C."

In view of the fact that the valves you saw Mr. Boyden test on April 12th did open to discharge train-pipe air from the passages C in the fifth test, where the brakes were to be applied quickly, is it not evident that the pistons D of those valves fitted as tight as the patent 217,838 contemplated?

Objected to as fully answered in reply to X Q. 919, wherein the witness states that the valves undoubtedly did not fit as tight as the patent contemplated, and gives his reason shown by the tests made by Mr. Boyden.

Counsel for defendants objects to the objection as being useless

and improper and in the nature of testimony, and because if the question was believed and understood that the question as last presented, which differed from the former question, had been fully answered, it was proper for him alone to say so. Counsel for complainants suggests that the propriety of objections should be best determined by the court.

A. They did not fit as tightly as the patent contemplated, for the reason already stated, namely, that previous tests showed that a complete exhaustion of train-pipe pressure could be made and the brakes set with full force without causing the opening of the passages C.

921 X Q. Was the previous test made by Mr. Boyden, to which you refer, the one he has designated "second," where the engineers' valve handle was placed in the "graduating position?"

A. Yes.

922 X Q. Please to point out, if you can, in the specification of patent 217,838, any direction that the proportions of the parts as shown in the drawings, or the fits of the parts, shall be adhered to.

A. Referring to the specification, I find this statement: "And I do hereby declare the following to be a full, clear, concise and exact description thereof, reference being had to the accompanying drawings making a part of this specification." And I also find the following matter contained in the specification: "The form or construction of the relief valve, its function and operation being substantially retained, may be varied considerably, in so far as it is an element in the described combination, without any material departure from the scope of the invention."

It seems perfectly clear to me that these instructions and statements clearly indicate that the functions and proportions of the device, as described and illustrated, are to be retained, whatever changes may be made in its form or mode of construction.

A reference to the drawings also clearly shows that they are suitable for working drawings, and were probably copied from them, and there is no reason to believe that valves made in accordance with these drawings would not operate substantially in accordance with the description of the patent.

923 X Q. Referring to your answer to Q. 896, I ask what "intended operation of the device of patent 217,838" was destroyed, as you say, by making the pistons D one sixty-fourth of an inch smaller?

A. The downward movement of piston D and opening of piston C, when a reduction of pressure was made in the front of the train-pipe communicating with passage A, except when excessive or unusual reduction of pressure was made in the front of the train-pipe.

924 X Q. Is the excessive or unusual reduction of pressure made in the front end of the train-pipe, such a reduction as was made by the engineers' valve in the year 1879, when the

engineer desired to apply the air brakes in the shortest time and with the greatest power?

A. Yes.

925 X Q. Then I understand from your testimony that the valve devices which Mr. Boyden tested in your presence, would not open the passages C when the engineers' valve handle was placed in the graduating position to slowly apply the brakes, but that said passages C did open when the engineers' valve handle was placed in the emergency position to quickly apply the brakes with full forces; am I correct?

A. In the experiments made by Mr. Boynton the brakes were applied with full force when the handle of the engineers' valve was placed in graduated position, but there was no opening of the passages C with the handle of the engineers' valve in this position. The brakes were applied with full force, and more quickly, when the handle of the engineers' valve was placed in the emergency position and air escaped from the passages C from the train-pipe to the atmosphere.

926 X Q. In the graduating test made by Mr. Boyden, when the engineers' valve handle was placed in the "graduating position," and then blanked, were not the brakes gradually and partially applied?

A. They were.

927 X Q. Then my last previous question 925 could have been correctly answered by a simple affirmative response, could it not?

A. I think it is more completely answered in the response made to that question, as I desired to have it clearly understood that a full application of the brakes was made with the handle of the engineers' valve in the graduating position, as well as in the emergency position.

It might have been inferred from the question that a full application of the brakes was not obtained with the handle of the engineers' valve in the graduating position.

1358 928 X Q. In your answer to questions 897 and 898, you state that "brakes are very frequently released with the handle of the engineers' valve in the running position." Now, I ask, would you, as an officer of the Westinghouse Air Brake Company, recommend the practice of releasing the brakes in a fifty-car train, when using a Westinghouse engineers' valve, like that used by Mr. Boyden in his tests, by placing the handle of the engineers' valve in the running position, and not in the full release position?

A. I should not recommend the use of the port of the running position of the engineers' valve used by Mr. Boyden in his tests, under all circumstances, for the purpose of releasing brakes on a fifty-car train, but it certainly can be used to very great advantage, for the purpose of releasing brakes under the conditions named, and in regular practice is made use of for that purpose. I certainly should not consider valve devices that could not be released on a fifty-car train by the use of this method of releasing brakes, to be of any practical value, particularly when operated under the conditions that existed when Mr. Boyden made his tests.

929 X Q. Do you not, in any of your books of instruction or descriptive catalogues of air brakes, as issued by your company, distinctly state, that the handle of the engineers' valve should be placed in the full release position, and after the brakes have released, return the handle to the running position?

Objected to as immaterial.

A. Our most recent printed instructions state that on trains of moderate length, the brakes can be released and auxiliary reservoirs recharged, by placing the handle of the engineers' valve in running position. Previous publications have instructed engineers to handle the valve substantially in the manner described in your question.

930 X Q. In your answer to Q. 898, you give expression to your views as to how different parts of the air brake should operate; this testimony has reference, as it not, to the superior air brakes that are in use at this present time?

A. In reading over the answer of the question referred to, I find that any opinions that I expressed in that answer, relative to the working of air brakes, were intended to apply to automatic brakes as they were made in 1879.

931 X Q. Please state whether the engineers' valve which you saw Mr. Boyden use in the tests he made, and which you referred to in your answer to Q. 898, was the kind of engineers' valve that was in use in the year 1879?

A. It was not.

932 X Q. Then so much of your answer to Q. 898 as related to the working of air brakes by this engineers' valve, was not intended to apply to automatic brakes as they were made in 1879. Am I not right?

A. The answer in question was not given for the purpose of stating any particular method of operating any particular kind of brake at any particular time. What I wished to express, in a general way, was the fact that automatic brakes in good condition should be readily released by a very moderate increase of pressure in the train-pipe. It is a matter of no importance what kind of an engineers' valve is used for this purpose.

H. H. WESTINGHOUSE.

Adjourned *sine die*.

1361

Opinion.

Filed March 11, 1895.

In the Circuit Court of the United States for the District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WESTINGHOUSE AIR BRAKE COMPANY vs. THE BOYDEN POWER BRAKE COMPANY.	}	In Equity.
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MORRIS, *District Judge* :

This is a bill in equity, in usual form, charging the defendant with infringing the Westinghouse patent No. 360,970, dated March 29, 1887, for a fluid-pressure automatic brake mechanism.

The claims alleged to have been infringed by the defendant, are claims 1, 2 and 4, which are as follows :

"1. In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake-cylinder, a triple valve, and an auxiliary-valve device, actuated by the piston of the triple valve and independent of the main valve thereof, for admitting air in the application of the brake directly from the main air pipe to the brake-cylinder, substantially as set forth.

"2. In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake-cylinder, and a triple valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake-cylinder, and which by a further traverse admits air directly from the main air pipe to the brake-cylinder, substantially as set forth.

"4. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere respectively, and an auxiliary valve actuated by the piston stem and controlling communication between passages leading to connections with a main air pipe and with the brake-cylinder, respectively, set forth."

The only defence now urged by the defendant is non-infringement.

The history of the pioneer inventions of George Westinghouse, Jr., in fluid pressure brakes, by means of which the brakes of a train of railroad cars can be operated by air pressure controlled by the engineer of the train, and the history of the successive steps and inventions by which he has devised mechanisms adapted to apply that power so as to act automatically on each car, and the scope and fundamental importance of his later inventions by which he has accelerated in an astonishing degree, the quickness with which the brakes can be applied almost simultaneously on each car of a long

train consisting of as many as fifty freight cars, has been carefully and fully stated by Judge Townsend, who delivered the opinion in the case of *Westinghouse vs. New York Air Brake Co.*, 59 Fed. Rep. 962, and in the opinion of Judge Lacombe, filed December 27, 1894, in a case between the same parties in the United States circuit court for the southern district of New York.

The patent now in suit, No. 360,070, March 29, 1887, is the first of the Westinghouse patents in which he describes an additional function engrafted upon his automatic air brake, which is intended to be used only in cases of unusual emergency and which is intended to meet the difficulties of applying air brakes quickly on long trains. The purpose of the device was to increase the quickness of the serial action of the automatic brake mechanism on each successive car by making the triple-valve device of each brake mechanism set in operation the valves on the car immediately in its rear, and at the same time to make use of the train-pipe air vented for this purpose from the train-pipe at each triple valve, so as to add its power to the power supplied from the auxiliary reservoir of each car.

The result which Westinghouse was seeking in the new device described in patent No. 360,070, was first and principally to vent the train-pipe at each car so as to quicken the serial action of the brakes from car to car; and, secondarily, to utilize the vented air and not waste its power.

Westinghouse discovered that he could accomplish this result by so constructing the ordinary triple valve of his automatic mechanism that, in an emergency, the engineer by widely opening his engineers' valve, and thereby causing sudden and unusual release of pressure in the train-pipe could cause the piston of the triple valve to make an unusual and further traverse and thereby actuate a valve, which opened a port by which the train-pipe air was admitted suddenly and directly into the brake-cylinder, without passing through the auxiliary reservoir.

This sudden release of air from the train-pipe vented that pipe at the first car, and that venting in like manner released the pressure in the train-pipe at the valve of the next car, and so on from car to car with almost instantaneous rapidity.

It is shown that this device, as first constructed, was not entirely successful. It applied the brakes with greatly increased serial rapidity as compared with any former device and with much greater power, but not so quickly—but that the rear cars impinged against the forward ones with destructive shocks.

The reason for this appears to have been that the operation of venting was not carried far enough, because the port opened by the auxiliary valve was not of sufficient size and did not release the full volume of train-pipe air suddenly enough to vent it sufficiently. This defect was remedied by an improved mechanism devised by Westinghouse and described in his patent No. 376,837, January 24, 1888.

The success of this improved device has demonstrated that the invention by which the further traverse of the triple-valve piston

beyond the extent of the traverse required for the ordinary application of the brakes is made to admit a large volume of train-pipe air directly to the brake-cylinder was one of great importance.

1364 The proofs show that a quick-action automatic brake, which would give the results which this brake has accomplished, was eagerly sought after by inventors and car-builders, and all had failed, until Westinghouse discovered that it could be done by this mode of operation.

In the cases above referred to, in which this patent, No. 360,070, and the improvement on it, No. 376,837, were discussed with reference to the state of the art and the scope of the invention therein disclosed, these were held to be patents of a fundamental pioneer class describing an invention of primary importance.

In those cases the defendants, who were charged with infringing, were using a separate and independent valve to open the port to the train-pipe, and the question was whether or not Westinghouse was restricted to the form of independent valve and the precise mode of actuating it set out in his patent. It was held that he was entitled to a liberal construction of his claims, and that, in respect to the emergency valve, the form of his device was not of the essence of his invention.

In the Boyden mechanism, which is alleged in this case to infringe, I have not been able to satisfy myself that Boyden makes use of an auxiliary valve in the sense in which that term is employed in the specification and in some of the claims of the patent No. 360,070, now in suit.

It appears from the specification of patent No. 360,070, that what Westinghouse meant by the auxiliary valve, which is made one of the elements of the combination in the first and fourth claims, is such a valve as he has described in his specification, and which is independent of and performs none of the functions of the main valve of the ordinary triple-valve device, and I am not satisfied, notwithstanding the very positive testimony of the complainants' experts, that the poppet valve 22 of the Boyden mechanism is such a valve, for Boyden's poppet valve 22 does, as I understand its operation, to some extent perform the functions of a main valve of the triple valve, as well as the function of Westinghouse's auxiliary quick-action or emergency valve.

1365 It is probably true that in the Boyden mechanism, the stem valve *i, k, j*, which I take to be the equivalent of the sensitive graduating valve shown in the Westinghouse patent No. 220,556, October 14, 1879, is so constructed that it may do, and probably in most cases does do, the work of ordinary breaking, that is to say, that by two or three successive applications of pressure through that smaller and more sensitive valve the brake-cylinder is filled and the main valve 22 becomes non-essential, or, if lifted off its seat, is moved very gently; but valve 22 will, if the engineer uses his brake-valve carefully, do the work of a main valve, as is demonstrated, I think, by the experiments in which the sensitive graduating valve *i, k, j*, was plugged up. So I take it that defendants' valve *i, k, j*, must be held to be the sensitive graduating valve

usual in triple-valve devices since the Westinghouse patent No. 220,556; and the defendants' valve 22 must be considered to be the main valve, and that in defendants' mechanism he has been able, by an ingenious arrangement restricting the admission of auxiliary reservoir air to the triple-valve chamber, to cause the main valve to do both main valve work, when needed, and to do quick-action work when needed.

As by the explicit terms of claims 1 and 4, Westinghouse has restricted himself, as to those claims, to an auxiliary valve independent of the triple valve, I hold that the defendant does not infringe those claims.

Claim 2.

Claim 2 reads as follows:

"2. In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake-cylinder, and a triple valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake-cylinder, and which by a further traverse admits air directly from the main air pipe to the brake-cylinder, substantially as set forth."

The first three elements of this claim are the usual mechanism of an automatic air brake; the remaining element, which was the only novel one at the date of the patent, is a triple valve having a piston which by two distinct movements performs two distinct functions, the first its preliminary traverse by which it admits air from the auxiliary reservoir to the brake-cylinder, which is the ordinary effect of the usual movement of the triple-valve piston, and the second, its further traverse, which is a new and distinct use, admitting air directly from the main air pipe to the brake-cylinder, resulting in venting the main air pipe and in producing the quick action.

Now this, as I understand it, was the invention which Westinghouse brought to light. He discovered, and by experiment demonstrated, that by a further traverse of the triple piston train-pipe air could be vented from the train-pipe and that it would give two very important results, namely, first, quickening of the action of the brakes from the forward to the rear cars, so that the application of the brakes became almost instantaneous on all the cars, and, second, utilizing the vented air for direct action in the brake-cylinder. Now, although quick-action emergency brakes were being sought for, no one before Westinghouse had accomplished this result, and the means by which he accomplished it were entirely novel. Indeed, upon first impression it is paradoxical and startling to find that when a sudden, quick and powerful application of brakes is needed in the face of impending danger, it is to be obtained by a sudden large release of the pressure in the train-pipe, to the extent of fifteen or twenty pounds below that in the auxiliary reservoir, and that by using this low-pressure air to operate the brake-cylinder, instead of the air under greater pressure stored in the auxiliary reservoir, this remarkably effective application of the brakes is obtained. In the domain of quick-action brakes, this device would

seem to belong to that class of pioneer inventions, the patents for which are to be construed so as to be coextensive with the real invention, if the language of the claim will permit it.

It is shown that Westinghouse was the first who used a further traverse of the triple-valve piston to perform the operation required to vent the train-pipe into the brake-cylinder, to effect quick action. The result was new and the means were new. His claim 2 is broad enough in language to cover every device in which that is
1367 done by the further traverse admitting air directly from the train-pipe to the brake-cylinder, substantially by the means described in the specification, that is, by the further traverse actuating a valve which so admits the train-pipe air.

The result accomplished by defendant's mechanism is identical with that of Westinghouse, and the means by which the mechanism is actuated so alike that in its published trade catalogue defendant claims that cars fitted with its valves can be used on the same trains with the Westinghouse quick-action brake, because the engineer in applying or releasing the air pressure may treat them as identical; the same functional operations of the valves and the same results being obtained from the same changes in the engineers' brake-valve, so that there is strong *prima facie* reason to suppose that Boyden's way of using the same release of pressure to vent the train-pipe and to actuate the valves, which produces identical results, may be Westinghouse's way.

In mechanisms actuated by air under pressure, the transmission of power is not visible to the senses as plainly as when it is done by cranks and levers, and being transmitted by an invisible agency in all directions in which the air can escape, the functions of the instrumentalities by which it operates are more important than their forms, and in judging of an infringement we are to direct our minds rather to functional equivalents than mechanical equivalents.

The use by Boyden of a central opening through the triple-valve piston to admit train-pipe air to the triple-valve chamber was not new, nor the use of a poppet valve for the main valve of the triple, both of these constructions having been shown in the Westinghouse patent No. 141,685, August 12, 1873, and in others of his patents. So that there is nothing in the Boyden device not before exhibited in some one of the Westinghouse patents, except that he has been able to cause one of the valves of the triple (valve 22) at one stage of the application of brakes to perform ordinary service work, and at another to do quick-action works. This Boyden does by ingenious construction not before used, by which he restricts the passage of auxiliary reservoir air into the triple-valve chamber, so
1368 that when the further traverse of the piston suddenly unseats the poppet valve 22 the port opened by it to the brake-cylinder is so large and the supply of auxiliary reservoir air through the restricted passage so feeble, that the train-pipe air raises its check-valve and vents itself into that chamber and thence through the large port to the brake-cylinder. For the mechanism embodying this ingenious contrivance by which the poppet valve 22 is made capable of doing ordinary service work by a careful intermittent,

slow release of pressure by the engineer, and quick-action work by a quick sudden release, patents were granted to Boyden (No. 481,134, August 16, 1892, and No. 481,135, August 16, 1892); but if this construction contains the underlying invention of the patent in suit, which was granted March 29, 1887, Boyden cannot make use of his improvement during the life of that patent.

It is true that in searching for some device which would give quick action, Westinghouse had, before the date of the patent in suit, conceived the idea that it might be accomplished by venting the train-pipe at intervals along the train. He had tried having two or three vents at intervals in the length of the train controlled by electrical apparatus, and also had tried relief valves placed in pipe coupling of each car which would open to the atmosphere and vent the train-pipe quickly in case of accident or other sudden release of pressure in the forward part of the train. This was shown in the Westinghouse patent No. 217,838, July 22, 1879, but neither of these attempts were successfully applied, and they did not solve the problem of quick action.

The problem was not solved; indeed, the first step in the direction of solving it does not appear to have been taken until the experiments which led to the Westinghouse patent now in suit. The substance of the method then devised is the use of the sudden further traverse of the triple-valve piston to open a valve in a manner different from the valve opening made by the preliminary traverse for service braking, thereby admitting train-pipe air to the brake-cylinder without its passing through the auxiliary reservoir.

In the Westinghouse apparatus the further traverse of the triple-valve piston causes it to impinge against an additional separate valve which admits the train pipe air. In Boyden's apparatus used by the defendant, the further traverse pulls the poppet valve 22, which Boyden substituted for the ordinary main valve of the triple, suddenly off its seat, thereby, in the manner before mentioned, causing the train-pipe air to raise the check-valve and flow with volume through the triple-valve chamber direct to the brake-cylinder. The device in Boyden's apparatus, by which the difference of pressures in the triple-valve chamber between auxiliary reservoir air and the train-pipe air is produced and used, is ingenious and admirable; but the result obtained is just the same as when in the Westinghouse apparatus the auxiliary valve is unseated, and the means used are, in my judgment, functionally equivalent.

Under the ruling of *Morley Machine Co. vs. Lancaster*, 129 U. S., 263, and of the many cases cited in the opinion delivered in that case, the rights of a pioneer inventor are infringed by one who accomplishes the same result by means which, although never used for that purpose before, are mechanical equivalents for the means used by the inventor under a liberal construction of his patent. It was said in that case by Mr. Justice Blatchford (page 273): "Where an invention is one of a primary character and the mechanical functions performed by the machine are, as a whole, entirely new, all subsequent machines which employ substantially the same

means to accomplish the same results are infringements, although the subsequent machine may contain improvements in the separate mechanisms which go to make up the machine."

In *McCormick vs. Talcot*, 20 How., 402, the controversy arose over a device which McCormick had added to his reaper called a divider, intended to separate the standing grain to be left from that which is to be cut. The court said: "If he be the original inventor of the device or machine called the divider, he will have the right to treat as infringers all who make dividers operating on the same principle and performing the same functions by analogous means or equivalent combinations, even though the infringing machine be an improvement of the original, and patentable as such."

In *Machine Co. vs. Murphy*, 97 U. S., 120-125, it was said: "Nor is it safe to give much heed to the fact that the corresponding device in two machines organized to accomplish the same result is different in shape or form the one from the other, it is necessary in every such investigation to look at the mode of operation or the way the device works, and at the result, as well as at the means by which the result is attained."

The language of the Supreme Court in *Consolidated Valve Co. vs. Crosby Valve Co.*, 113 U. S., 157-171, is applicable:

"The prior structures never effected the kind of result attained by Richardson's apparatus because they lacked the thing which gave success. * * * Taught by Richardson, and by the use of his apparatus, it is not difficult for skilled mechanics to take prior structures and so arrange and use them as to produce more or less of the beneficial results first made known by Richardson."

It is true that a patentee can claim nothing beyond the scope of his patent (*Keystone Bridge Co. vs. Phoenix Iron Co.*, 95 U. S., 27-28) but the scope and meaning of a broad claim in the patent can only be interpreted by an understanding of the real scope of the invention itself.

If the Westinghouse patent now in suit is for an invention of primary character, and if the gist of that invention is the use of the further traverse of the triple-valve piston to open a valve which admits air directly from the train-pipe to the brake-cylinder, with the result that the train-pipe is vented and the train-pipe air utilized, then it appears to me that the defendant cannot exculpate itself from the charge of infringement by the fact that in its device the train-pipe air is admitted through the triple-valve chamber and not through a by-passage, nor by the fact that in its device the further traverse of the piston opens the main valve in a special manner which produces the same result, but does not make use of a separate auxiliary valve, provided Westinghouse has not by the explicit terms of his claim 2 restricted himself to the use of an auxiliary valve.

I do not think Westinghouse has so restricted himself in claim 2, although he does appear to have done so in claims 1 and 4.

There is without question some difficulty and embarrassment in the broad construction of claim 2, growing out of the proceeding in 1371 in the Patent Office, as shown by the file-wrapper and con-

tents; but considering what was the real invention, I am not of the opinion that the legal effect of those proceedings is to restrict claim 2 to a device containing a separate auxiliary valve.

From the contents of the file-wrapper it appears that, as the application was prepared, the first claim of patent No. 360,070 differed from that which now appears in the patent as granted.

The claim 1 first proposed was: "1. In a brake mechanism the combination of a main air pipe, an auxiliary reservoir, a brake-cylinder, a triple valve provided with a device for admitting air directly from the main air pipe to the brake-cylinder, substantially as set forth."

It was objected by the Patent Office examiner that this claim and also claim 2 were anticipated by patent No. 280,285, to G. A. Boyden, June 26, 1883, and the examiner requested that a working model of the triple valve should be furnished.

Boyden's patent of 1883, No. 280,285, was a form of triple-valve mechanism intended for use with Westinghouse's automatic air brake, the object of which was to provide for replenishing the auxiliary reservoir of each car when the pressure therein had been lessened by leakage and while the brakes remained applied. This was done by the engineer causing, not a release, but a slight increase of the pressure in the train-pipe air, which, acting upon a check-valve in the centre of the triple-valve piston, by a peculiar arrangement of the valves, caused train-pipe air to pass together with auxiliary reservoir air to the brake-cylinder. The object, function and result of whatever was new and patentable in this Boyden device was altogether different from the object, function and result of the Westinghouse device in patent No. 360,070, and there seems to be no analogy or comparison which can be made between them.

It is true that the "always-open one-way passage" in the Boyden patent which, when the check-valve was raised, allowed train-pipe air to reach the brake-cylinder, was, in the language of the cancelled claim 1 of No. 360,070, "a device for admitting air directly from the main air pipe to the brake-cylinder," and there were 1372 other devices used by Westinghouse himself which this wording would include; and the claim was, therefore, justly open to the criticism of the patent examiner, but there was no similarity in the means by which the two devices were actuated, no similarity in the object to be accomplished and no similarity in the mechanical principle of operation. It was simply a fact that there did exist in the Boyden device a passage for train-pipe air direct to the brake-cylinder which the engineer could cause to open by a slight increase of train-pipe pressure; but there was no hint or suggestion of the important discovery how that fact could be utilized to accomplish the entirely new function necessary to create a quick-action brake when, in an emergency, quick action was needed; and how, when quick action was needed, it should not interfere with ordinary graduation and service stops. This Boyden device was not in the direction of quick action, but its opposite.

While, therefore, it was proper that Westinghouse's original claim 1, should be corrected so as to express more definitely his

real invention, this was not because the Boyden patent in any manner whatever anticipated that invention or suggested it in any of its functions.

For the same reason there was then inserted in the specification of the Westinghouse patent No. 360,070, this clause:

"I am aware that a construction in which 'an always-open or way passage' from the main air pipe to the brake-cylinder is uncovered by the piston of the triple valve simultaneously with the opening of the passage from the auxiliary reservoir to the brake cylinder has been heretofore proposed, and such construction, which involves an operation different from that of my invention, I therefore hereby disclaim."

In the Boyden infringing device now used by the defendant, the passage from the main air pipe to the brake-cylinder is not "uncovered by the piston of the triple valve simultaneously with the opening of the passage from the auxiliary reservoir to the brake cylinder;" if it was, the defendant's mechanism would be always a quick-action brake and never anything else, but, on the contrary, in the infringing device, the passage is not opened until there has been a sudden further traverse of the piston, which the 1373 brings it into operation for the distinct purpose of quick action. The statement of the so-called disclaimer is strictly true that the construction of the Boyden 1883 patent "involves an operation different from" the Westinghouse invention, and the so-called disclaimer in reality disclaims nothing which has relation to the Westinghouse quick-action invention.

The disclaimer was substituted in the place of the following which had been in the specification and was cancelled:

"Further, while in the specific construction described and showing the function of admitting air from the main pipe is performed by a valve separate from that which effects the preliminary admission of reservoir pressure to the cylinder, a modification in which the same office is performed by a valve integral with the main valve and formed by an extension thereof, would be included in and embodied the essential operative features of my invention."

The testimony tends to prove that this clause of the specification was taken out because the examiner objected that no such form of triple valve was illustrated in the drawings. For whatever reason it may have been cancelled, it is not a necessary result that the patentee is precluded from claiming that his patent covers other forms of valve integral with the main valve, if such is his legal right when his invention, as disclosed in his patent, is found to be a broad one, and if he is not restricted by his claims and if he has done nothing to impair his right to be protected in his whole invention. The effort should be to preserve, rather than to forfeit the inventor's rights.

Keystone Manufacturing Co. vs. Adams, 151 U. S., 144.

The object and scope of the invention and the means employed to effect his object are thus stated by Westinghouse in the specification of his patent in suit.

"The object of my invention is to enable the application of brake-shoes to car wheels by fluid pressure to be effected with greater rapidity and effectiveness than heretofore, more particularly in trains of considerable length, as well as to economize compressed air in the operation of braking by utilizing in the brake-
 1374 cylinders the greater portion of the volume of air which in former practice was directly discharged into the atmosphere. To this end my invention generally stated, consists in a novel combination of a brake-pipe, an auxiliary reservoir, a brake-cylinder, and a triple-valve device governing, primarily, communication between the auxiliary reservoir and the brake-cylinder; and, secondarily, communication directly from the brake-pipe to the brake-cylinder."

This language exactly describes the infringing mechanism of the defendant.

The amendments made to meet the objections of the patent examiner are not to be construed to disclaim the patentee's actual invention, if such construction can be avoided without doing violence to the obvious meaning of the language.

Lake Shore Railway Co. *vs.* Car Brake Co., 110 U. S., 229-236.

Reese Button Hole Machine Co. *vs.* Globe Button Hole Co., 61 Fed. Rep., 956.

It has been urged that the invention disclosed by the patent in suit is not of a meritorious character because in the form in which it is there embodied, or at least in the first mechanism manufactured by Westinghouse, it failed of success in some essentials, and was immediately improved by Westinghouse in a manner which was the subject of a subsequent patent, before it was successful in the use for which it was intended. The defect developed by experimental test and which Westinghouse in a few months remedied was that the opening uncovered by the auxiliary valve was not sufficiently large to suddenly release the full volume of train-pipe air. This was not a defect inherent in the device.

59 Fed. Rep., 581-591.

There were structural objections to making that opening large, but when made larger, the device answered the purpose for which it was intended. It was thought, however, better to remedy the difficulty by adding an auxiliary piston as well as an auxiliary valve, and it was in that line that Westinghouse carried his further improvements, and he has adopted that form as the best to be manufactured for general use.

1375 This defect in the patent in suit was not radical and was only one of those defects common in the first forms of many pioneer inventions which usually have to be improved upon before they attain commercial success.

It is further urged that in a doubtful case the scale should be turned by the fact that subsequent to the date of the patent in suit, indeed more than two years after the institution of this suit, patents

Nos. 481,134 and 481,135, August 16, 1892, were granted to Boyden for the mechanism now used by the defendant.

Boyden was entitled to patents for whatever was a patentable novelty in the devices by which he was able to make his valve 22 answer for both service and quick-action work in connection with the restricted passage B, and for any other patentable novelty in the forms of his mechanism. The widely different forms in which he has illustrated his devices in the two above-mentioned patents show that taking what Westinghouse had discovered and demonstrated to be the underlying principle of a quick-action brake, a skillful and inventive mechanic can devise many forms for applying it.

But in his specification of patent No. 481,134 and No. 481,135, Boyden alleges that his device differs essentially from Westinghouse's patent No. 360,070, and involves a new mode of operation. The question whether it does or not was the very question pending in this suit, and so far as the examiner passed upon it in allowing the specification to stand, he did so upon the *ex parte* application of Boyden and unassisted by testimony as to the state of the art at the date of the Westinghouse patent, without testimony as to the scope of the Westinghouse quick-action invention and its great importance and merit; and, therefore, without the opportunity of judging whether or not it was a pioneer invention of a fundamental character entitled to a construction coextensive with the invention, or was simply a patent for an improvement in a known art to be restricted to the form of the device shown in the model and illustrations.

The determination of that question is the starting point in 1576 the consideration of the controversy, and, in my judgment, the fact that Westinghouse was the first discoverer of the vital underlying invention, should turn the scale in his favor.

The complainants are entitled to a decree for an injunction and account, with a reference to a master in the usual form.

Decree.

Filed April 25, 1895.

United States Circuit Court, District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WESTINGHOUSE
AIR BRAKE COMPANY

vs.

BOYDEN POWER BRAKE COMPANY; GEORGE A. BOYDEN,
President; Charles B. Mann, Secretary; William
Whitridge, Treasurer, and Boyden Brake Company.

In Equity.
No. 321.

And now, to wit, this 25th day of April, 1895, the above-entitled cause having come on regularly for hearing, before the Honorable Thomas J. Morris, district judge, holding circuit court, on bill, answer, replication and proofs taken by and on behalf of the respective parties hereto, and having been argued by Mr. George H. Christy

and Mr. Frederic H. Betts, for complainants, and by Mr. Lysander Hill, Mr. Skipwith Wilmer and Mr. Hector T. Fenton, for defendants, and the court having considered the same, and being duly advised in the premises, it is thereupon ordered, adjudged, and decreed:

377 1st. That the letters patent recited in complainants' bill of complaint, to wit, letters patent of the United States, No. 360,070, dated March 29, 1887, and granted to George Westinghouse, Jr., for a new and useful improvement in fluid-pressure automatic brake mechanism, are a good and valid patent in all respects as regards and to the extent of the subject-matter of invention referred to and summed up in the several claims declared upon herein, to wit, claims numbered one, two and four of said recited patent; that George Westinghouse, Jr., was the true, original and first inventor thereof; and that the complainants have a good and sufficient title thereto, and are entitled to the exclusive right therein and thereunder.

2d. That the defendants above named, by the manufacture, use and sale of fluid-pressure automatic brake mechanism, as set forth and shown in and by the proofs herein, and (for greater certainty herein) more particularly as shown and described in certain letters patent of the United States, No. 481,134 and No. 481,135, both dated August 16, 1892, and both granted to The Boyden Brake Company, assignee of George A. Boyden, defendants herein, have infringed the said second claim of said recited patent No. 360,070, and have violated the exclusive right of the complainants therein and thereunder, and that a writ of injunction, conformable to the prayer of said bill, and in the usual form, be issued by the clerk, perpetually enjoining and restraining the said defendants and each of them from any further manufacture, use or sale of the apparatus, mechanism and devices complained of herein, and of and other apparatus, mechanism or devices substantially such in construction and operation as that which is referred to in and constitutes the subject-matter of said second claim, and from doing any act or thing in infringement of said second claim, or in violation of the exclusive right so as aforesaid vested in said complainants therein and thereunder.

3d. That reference be made herein to G. Morris Bond, Esq., as master, to take, state and make return of an account of the gains and profits made by said defendants, as also of the damages suffered by said complainants by or on account of said infringement, 1378 and that the parties appear before the master and produce books and papers and render accounts as he may, from time to time, direct.

4th. That as regards claims one and four of said patent No. 360,070, the court being of the opinion that defendants' device hereinbefore referred to does not infringe the same, injunction is refused and the bill of complaint is, in reference to such claims, hereby dismissed.

5th. And it is further ordered that all questions of the allowance of costs are reserved until the final decree.

THOS. J. MORRIS, *Judge.*

Petition for Appeal; Order Thereon Allowing the Appeal and Assignment of Errors.

Filed April 29, 1895.

United States Circuit Court, District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WEST-
INGHOUSE AIR BRAKE COMPANY
vs.

BOYDEN POWER BRAKE COMPANY; GEORGE
A. Boyden, President; Charles B. Mann,
Secretary; William Whitridge, Treasurer,
and Boyden Brake Company. } In Equity. No. 321.

To the Hon. Thomas J. Morris, judge:

And now, April 29th, 1895, come the defendants into court by Messrs. Barton and Wilmer their solicitors, and pray for allowance of an appeal to the United States circuit court of appeals for 1379 the fourth circuit from the interlocutory decree in said cause entered the 25th day of April, 1895, awarding an injunction and account as prayed in the bill of complaint in respect of the 2d claim of the letters patent in suit, that a proper citation may be issued and served upon the plaintiffs in said case, or their solicitors, and that a transcript of the record, proceedings and evidence in said case, duly authenticated, may be transmitted to said circuit court of appeals.

BARTON & WILMER,
Sol's for Defendants.

Whereupon it is now ordered this 29th day of April, 1895, that said appeal be and is hereby allowed.

And it is further ordered that security on appeal in the sum of five hundred dollars be entered by the appellants.

THOS. J. MORRIS, *Judge.*

Assignment of Errors.

United States Circuit Court of Appeals, Fourth Circuit.

THE BOYDEN POWER BRAKE COMPANY *et al.*, Appel-
lants and Defendants Below,

vs.
GEORGE WESTINGHOUSE, JR., and THE WESTINGHOUSE
AIR BRAKE Co., Appellees and Plaintiffs Below. } In Equity.

And now, April 29th, 1895, come the appellants in above case, by their counsel, and say that in the record and proceedings therein there is manifest error in this, to wit:

1380 1st. The circuit court erred in adjudging the 2d claim of the patent in suit to be valid, because it is functional in form

and therefore legally incapable of interpretation as for a combination of mechanism.

2d. The circuit court erred in its interpretation of the 2d claim of the patent in suit, because said claim being functional in form, should, if capable of being sustained, have been construed to be for the mechanism described in the specification as essential in the performance of the function recited in the claim, and hence inclusive of an auxiliary valve actuated by the triple-valve piston on its further or full traverse, and thereby brought into register with an independent port and passage having no connection with the triple-valve mechanism.

3d. The court erred in its interpretation of claim 2 of the patent in suit, in that it held that said claim broadly covered any combination of valve mechanism (including a triple valve) in which train-pipe air was admitted to the brake-cylinder by a further or full traverse of the triple-valve piston.

4th. The circuit court erred in its construction of claim 2, because its adjudged interpretation thereof is based upon the erroneous premise that the "further traverse" of the triple-valve piston was a new and "unusual" motion or function of said device in this combination, whereas in truth and in fact said "further traverse" was the usual, old and ordinary function of the piston of the old and well-known triple valve; and whether new or old, usual or unusual, was and is wholly ineffectual to produce the function recited in the plaintiffs' device, without the addition of another and distinct port and passage leading to the brake-cylinder and another and auxiliary and additional valve governing the same and actuated by the triple-valve piston on its "further" traverse.

5th. The circuit court erred in construing claim 2 as a generic claim, because the plaintiff was estopped by its declarations made in its suit on its later patent No. 376,837, from claiming that the prior patent No. 360,070, in suit was in any sense a pioneer patent.

6th. The circuit court erred in broadly construing claim 2 of the patent in suit as for a combination of mechanism in which the auxiliary valve or its equivalent, as well as the port and the passage controlled thereby, need not necessarily be separate and independent of the triple-valve mechanism proper; because there is no warrant in the specification for any such interpretation of the claim.

7th. The circuit court erred in broadly construing claim 2 of the patent in suit as for a combination of mechanism in which the auxiliary valve or its equivalent, as well as the port and the passage controlled thereby, need not necessarily be separate and independent of the triple-valve mechanism proper, because the state of the art disclosed in the record legally precluded any such generic interpretation.

8th. The circuit court erred in broadly construing claim 2 of the patent in suit as for a combination of mechanism in which the auxiliary valve or its equivalent, as well as the port and the passage controlled thereby, need not necessarily be separate and independent of the triple-valve mechanism proper; because the declarations of

the patentee contained in the file of the application for the patent required as matter of law a narrower, more restricted and different interpretation.

9th. The circuit court erred in its interpretation of said second claim, because the plaintiffs' alleged invention being admittedly an improvement consisting only in the addition to the old and well-known triple-valve mechanism and without any change whatever in the latter, either in construction or function, of an independent element, arranged in juxtaposition with, so as to be actuated by, such triple-valve piston on its extreme traverse, and whereby such added element produced an additional result exclusively its own, should have been interpreted to be inclusive only of mechanism mechanically equivalent to such new and added part, and not as construed by the court to be inclusive of any mechanism generally capable of performing such new and additional result.

10th. The circuit court erred in adjudging that the defendants' apparatus infringed said second claim, because the defendants' device does not employ an auxiliary valve nor any equivalent super-added element to accomplish the new or additional result described in the claim, but performs the function and result recited in the claim by mechanism wholly different therefrom in principle of construction and operation, viz., solely by an ingenious modification of a chamber wall of the triple valve itself and without any additional passageway or port, or auxiliary valve governing such port and passage, or any mechanical equivalent for the same or any of them.

11th. That the circuit court erred in holding that the defendants have infringed the second claim of said patent No. 360,070, whereas, in law, it should have held that the defendants had not infringed said claim in view of the finding by the court that defendants poppet valve 22, is not an auxiliary valve.

12th. The circuit court erred in holding said 2d claim to be entitled to cover functional equivalents, whereas it should have held it entitled to cover only the means specified in the patent or their mechanical equivalents.

13th. The court erred in not giving proper weight and force to the disclaimers and limiting statements of the patent in suit, and to the record of proceedings in the Patent Office when said patent was applied for.

14th. The circuit court erred in granting an injunction restraining these defendants from manufacturing, selling and using air-brake apparatus constructed under, and in substantial accordance with, the patents granted to George A. Boyden, dated August 16, 1892, No. 481,134 and No. 481,135.

15th. The court erred in not giving proper weight and force to the statements contained in the patents to George A. Boyden, No. 481,134 and No. 481,135, in which the defendants' device is differentiated from the device of the patent in suit.

16th. The circuit court erred in construing the 2d claim as covering the defendants' device after finding that the poppet valve 22, must be considered to be the main valve of the triple-valve device

and admits the air from the main air pipe to the brake-cylinder, and that the device described in the specification of the patent in suit to perform that function, is a valve independent of, and performs none of the functions of, the main valve of the ordinary triple-valve device.

1383 17th. The court erred in awarding the injunction appealed from.

18th. The circuit court erred in not fully dismissing the bill.

Wherefore, the appellants, The Boyden Power Brake Company, *et al.*, pray that the decree of the circuit court of the United States for the district of Maryland, may be reversed by this honorable court, and that the said circuit court be directed by the mandate of this court to enter a decree rescinding the decree appealed from and directing a dismissal of the bill of complaint filed in said cause, with costs to the appellants and defendants below.

BARTON & WILMER,

Of Counsel for Appellants.

Appeal Bond.

Filed April 29, 1895.

Know all men by these presents, that we, the Boyden Brake Company, as principal, and Douglas H. Thomas, as surety, are held and firmly bound unto George Westinghouse, Jr., and the Westinghouse Air Brake Company, in the full and just sum of five hundred dollars, to be paid to the said George Westinghouse, Jr., and the Westinghouse Air Brake Company, his and their certain attorney, executors, administrators or assigns; to which payment, well and truly to be made, the Boyden Brake Company aforesaid binds itself and its successors or assigns, and the said Douglas H. Thomas binds himself, his heirs, executors and administrators, jointly and severally by these presents.

Sealed with our seals and dated this twenty-ninth day of April, in the year of our Lord one thousand eight hundred and ninety-five.

Whereas, lately at a circuit court of the United States for the district of Maryland, in a suit depending in said court, between George Westinghouse, Jr., and The Westinghouse Air Brake Company, complainants, and The Boyden Power Brake Company, George A. Boyden, president, Charles B. Mann, secretary, William Whitridge, treasurer, and The Boyden Brake Company, defendants, a decree was rendered against the said defendants, and the said defendants having obtained an appeal to reverse the decree in the aforesaid suit, and a citation directed to the said George Westinghouse, Jr., and The Westinghouse Air Brake Company, citing and admonishing them to be and appear at a United States circuit court of appeals for the fourth circuit, to be holden at Richmond, on the day in the said citation mentioned:

Now, the condition of the above obligation is such, that if the said defendants shall prosecute their appeal to effect and answer all

costs if they fail to make their plea good, then the above obligation to be void ; else to remain in full force and virtue.

In testimony whereof, the said Boyden Brake Company hath caused its corporate seal to be hereunto affixed, and George A. Boyden, its president, hath hereunto subscribed his name, and Douglas H. Thomas, the surety above named, hath also subscribed his name and affixed his seal, on the day and year aforesaid.

[Seal of the Boyden Brake Co.]

GEO. A. BOYDEN, *Pst.*
DOUGLAS H. THOMAS. [SEAL.]

Signed, sealed and delivered in presence of—
L. J. VAN HORN.

Approved by—
THOS. J. MORRIS, *Judge.*

1385 *Citation.*

UNITED STATES OF AMERICA, *ss :*

The President of the United States to George Westinghouse, Jr., and
The Westinghouse Air Brake Company, Greeting :

You are hereby cited and admonished to be and appear at a United States circuit court of appeals for the fourth circuit, to be holden at Richmond on the 25th day of May next, pursuant to an appeal from a decree of the circuit court of the United States for the district of Maryland in your favor, passed in a cause in said court wherein The Boyden Power Brake Company, George A. Boyden, president, Charles B. Mann, secretary, William Whitridge, treasurer, and Boyden Brake Company, are defendants, and you are complainants, to show cause, if any there be, why the decree rendered against the said defendants in said cause mentioned, should not be corrected, and why speedy justice should not be done to the parties in that behalf.

Witness, the Honorable Thomas J. Morris, judge
[COURT SEAL.] of the said circuit court of the United States, this
twenty-ninth day of April, in the year of our Lord
one thousand eight hundred and ninety-five.

THOS. J. MORRIS, *Judge.*

Test : JAMES W. CHEW,
Clerk U. S. Circuit Court, District of Maryland.

Endorsed.

Due service of the within citation acknowledged, this 29th day
of April, 1895.

BERNARD CARTER,
*Solicitor for George Westinghouse, Jr., and
The Westinghouse Air Brake Company.*

1386 *Order Permitting Withdrawal of Exhibits for Use in the United States Circuit Court of Appeals.*

Filed April 30, 1895.

United States Circuit Court, District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WEST-
INGHOUSE AIR BRAKE COMPANY

vs.

BOYDEN POWER BRAKE COMPANY; GEORGE
A. Boyden, President; Charles B. Mann,
Secretary; William Whitridge, Treasurer,
and Boyden Brake Company. } In Equity. No. 321.

Ordered by the court, this 30th day of April, 1895, that the defendants have leave to withdraw the following exhibits from the files of the court in order that they may be exhibited to the United States circuit court of appeals for the fourth circuit on the hearing of said cause on appeal.

Complainants' Exhibit, Defendants' 1891 Catalogue.

Complainants' Exhibit, Defendants' 1889 Catalogue.

Complainants' Exhibit Drawing Quick-action Automatic Freight
Brake.

Defendants' Exhibit, Westinghouse 1890 Instruction Book.

Defendants' Exhibit, Westinghouse 1886 Instruction Book.

Also such other of the original exhibits as counsel may desire to exhibit to said circuit court of appeals.

It is further ordered that before taking out said exhibits, a receipt shall be given to the clerk of the court for the return of the same after the hearing.

THOS. J. MORRIS, *Judge.*

1387 Thereupon it is ordered by the court here, that a transcript of the record and proceedings in the cause aforesaid, together with all things thereunto relating, be transmitted to the said United States circuit court of appeals for the fourth circuit, and the same is transmitted accordingly.

Test:

JAS. W. CHEW, *Clerk.*

UNITED STATES OF AMERICA, } *To wit:*
District of Maryland, }

I, James W. Chew, clerk of the circuit court of the United States for the fourth circuit in and for the district of Maryland, do hereby certify that the foregoing is a true transcript of the record and proceedings, together with all things thereunto relating, in the therein-entitled cause.

[COURT SEAL.] In testimony whereof, I hereunto set my hand and affix the seal of the said circuit court, this sixth day of May, A. D. 1895.

JAS. W. CHEW,
Clerk of said Court.

1388 *Transcript of Cross-appeal.*

United States Circuit Court of Appeals, Fourth Circuit.

GEORGE WESTINGHOUSE, JR., and THE WESTINGHOUSE AIR BRAKE COMPANY, Complainants and Appellants,	}	No. —.
<i>versus</i>		
BOYDEN POWER BRAKE COMPANY; GEORGE A. BOYDEN, President; Charles B. Mann, Secretary; William Whit- ridge, Treasurer, and Boyden Brake Company, Defend- ants and Appellees.		

Cross-appeal of the complainants from the decree of the circuit court of the United States for the district of Maryland.

Record filed May 14, 1895.

1389 *Transcript of Cross-appeal.*

United States Circuit Court of Appeals, Fourth Circuit.

GEORGE WESTINGHOUSE, JR., and THE WESTINGHOUSE AIR BRAKE COMPANY, Complainants and Appellants,	}	No. —.
<i>versus</i>		
BOYDEN POWER BRAKE COMPANY; GEORGE A. BOYDEN, President; Charles B. Mann, Secretary; William Whit- ridge, Treasurer, and Boyden Brake Company, Defend- ants and Appellees.		

Cross-appeal of the complainants from the decree of the circuit court of the United States for the district of Maryland.

1390 UNITED STATES OF AMERICA, }
District of Maryland, } *To wit:*

At a circuit court of the United States for the fourth circuit, in and for the district of Maryland, begun and held at the court-house in the city of Baltimore on the first Monday of April, being the first day of the same month in the year of our Lord one thousand eight hundred and nine y-five—

Present: The Honorable Thomas J. Morris, judge of the Maryland district; William L. Marbury, Esq., attorney; Charles H. Evans, Esq., marshal; James W. Chew, clerk—

Among other were the following proceedings, to wit:

GEORGE WESTINGHOUSE, JR., and THE WESTINGHOUSE
AIR BRAKE COMPANY, Complainants,
vs.
BOYDEN POWER BRAKE COMPANY; GEORGE A. BOY-
den, President; Charles B. Mann, Secretary; Wil-
liam Whitridge, Treasurer, and Boyden Brake
Company, Defendants. } In Equity.

1391 *Petition of Complainants for an Appeal, Order of Court Allow-
ing the Appeal, and Assignment of Errors.*

In the Circuit Court of the United States, District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WEST-
inghouse Air Brake Company, Complain-
ants and Appellants,
v.
BOYDEN POWER BRAKE COMPANY; GEORGE
A. Boyden, President; Charles B. Mann,
Secretary; William Whitridge, Treasurer,
and Boyden Brake Company, Defendants
and Appellees. } In Equity. No. 321.

The above-named complainants, George Westinghouse, Jr., and
The Westinghouse Air Brake Company, conceiving themselves ag-
grieved by so much of the interlocutory decree heretofore entered
in said cause, as relates to claims one and four of the patent in suit,
No. 360,070, do hereby appeal to the United States circuit court of
appeals for the fourth circuit from so much and such parts of said
decree as refuse an injunction under the claims numbered one and
four of the patent in suit, No. 360,070, or as contain or involve a
refusal of an injunction under said claims, and they pray that this,
their appeal, may be allowed, and that a transcript, duly
1392 authenticated of the record and proceedings in the above-
entitled cause, upon which so much of said decree was made,
may be transmitted with said appeal to the circuit court of appeals
for the fourth circuit, or if it be that such a transcript has already
been transmitted to the circuit court of appeals on the appeal of the
original defendants herein, then they pray that this, their appeal,
being a cross-appeal, may be allowed, and that a certified transcript
of so much of the record and proceedings herein as appertain to the
subject-matter of this appeal, and as have not already been certified
in said original appeal, as aforesaid, may be transmitted with this
appeal to the circuit court of appeals for the fourth circuit.

BERNARD CARTER,
Solicitor for Complainants.

Ordered, this 13th day of May, 1895, that the above appeal be
allowed as prayed for, and the clerk will certify accordingly; pro-
vided, the appellant shall refund to the appellees or to the clerk the
one-half of the cost of the transcript already transmitted.

THOS. J. MORRIS, *Judge.*

And *eo die* come the complainants in the above-entitled cause and file, with their foregoing petition for appeal, these their assignments of error:

1st. That the court erred in finding that defendants' apparatus did not contain an auxiliary valve within the meaning of claims one and four of patent No. 360,070, and of each of them.

2d. That the court erred in holding that it is an essential feature of the auxiliary valve of the patent in suit that it "performs none of the functions of the main valve of the ordinary triple-valve device."

3d. That the court erred in finding that the quick action or emergency valve 22 of defendants' apparatus is in any practical or operative or commercial sense a main valve, or that in practical use it has the capacity or does the work of a main valve, or that to any practical or material extent it "performs the functions of a main valve of the triple valve."

4th. That the court erred in holding that the valve *ij k* of defendants' apparatus is not a main valve within the meaning of claims one and four of patent 360,070 and of each or either of said claims.

5th. That the court erred in holding that the defendants' apparatus did not contain the invention of claims one and four and of each of them.

6th. That the court erred in not holding that in defendants' apparatus, and for the purposes of this case, the valve *ij k* is or represents the valvular appliance by or through which the ordinary service work of the brake is done, and valve 22 is or represents the valvular appliance by or through which quick action or emergency work is done, and also in not holding that such use and operation of defendants' apparatus involves an unauthorized use of the invention of claims one and four of patent 360,070, and is an infringement thereof.

7th. That the court erred in refusing and in not granting an injunction under each and both of said claims.

Wherefore, these appellants, George Westinghouse, Jr., and The Westinghouse Air Brake Company, pray that the decree of the circuit court of the United States for the district of Maryland may be

reversed by this honorable court in respect of the matters herein appealed, and that the said circuit court be directed

by the mandate of this court to enter a decree for an injunction and account under claims one and four of the patent in suit, No. 360,070, with costs to the appellants herein and complainants below.

BERNARD CARTER,
Solicitor for Appellants.

Service of copy of the within admitted this 13th day of May, 1895.

BARTON & WILMER,
Solicitors for Defendant.

Complainants' Appeal Bond.

Filed May 13th, 1895.

Know all men by these presents that we, George Westinghouse, Jr., and the Westinghouse Air Brake Company, as principals, and W. J. C. Dulany, of Baltimore, Maryland, as surety, are indebted to Boyden Power Brake Company, George A. Boyden, president; Charles B. Mann, secretary; William Whitridge, treasurer; and Boyden Brake Company, in the penal sum of five hundred dollars, good and lawful money of the United States, for the payment of which, well and truly to be made, we do bind ourselves, our successors, heirs, executors and administrators jointly and severally by these presents.

In testimony whereof, the said obligors above named have hereunto affixed their respective hands and seals this 13th day of May, A. D. 1895.

The condition of the above obligation is such that, whereas, in the cause now pending in the circuit court of the United States in and for the district of Maryland, wherein the said George Westinghouse, Jr., and The Westinghouse Air Brake Company are 1395 complainants, and the said Boyden Power Brake Company, George A. Boyden, president, Charles B. Mann, secretary; William Whitridge, treasurer; and Boyden Brake Company, are defendants, a decree was entered on the 25th day of April, A. D. 1895, by the Hon. Thomas J. Morris, judge of the said court, against the said Boyden Power Brake Company, George A. Boyden, president; Charles B. Mann, secretary; William Whitridge, treasurer; and Boyden Brake Company, defendants, in favor of the said George Westinghouse, Jr., and The Westinghouse Air Brake Company, complainants, among other things, enjoining the said defendants as therein set forth; and, whereas, the said George Westinghouse, Jr., and the Westinghouse Air Brake Company have prayed an appeal from said decree to the United States circuit court of appeals for the said circuit, which said appeal has been allowed.

Now, therefore, if the said George Westinghouse, Jr., and the Westinghouse Air Brake Company shall well and duly prosecute the said appeal with effect, and shall answer to the said Boyden Power Brake Company, George A. Boyden, president; Charles B. Mann, secretary; William Whitridge, treasurer, and Boyden Brake Company all costs by the said Boyden Power Brake Company, George A. Boyden, president; Charles B. Mann, secretary; William Whitridge, treasurer, and Boyden Brake Company sustained, in case they, the said George Westinghouse, Jr., and the Westinghouse Air Brake Company shall fail to sustain their said appeal, then, and in such case, the above obligation is to be void, otherwise to be, and remain, in full force and effect.

GEO. WESTINGHOUSE, JR. [L. s.]

[Seal of Westinghouse Air Brake Company.]

THE WESTINGHOUSE AIR BRAKE CO.,

By H. H. WESTINGHOUSE, *General Manager.*

WM. J. C. DULANY. [L. s.]

1396 STATE OF PENNSYLVANIA, }
County of Allegheny, } ss :

Before me, the undersigned authority, hereunto duly authorized, personally appeared George Westinghouse, Jr., and H. H. Westinghouse, general manager of the Westinghouse Air Brake Company, obligors above named, who acknowledged the foregoing signature as their voluntary act, for the purposes and uses therein set forth.

Witness my hand and official seal this ninth day of May, A. D. 1895.

[SEAL OF NOTARY.]

F. E. GARTHER,
Notary Public.

STATE OF MARYLAND, }
City of Baltimore, } ss :

Before me, the undersigned authority, hereunto duly authorized, personally appeared W. J. C. Dulany, obligor above named, who acknowledged the foregoing signature as his voluntary act for the purposes and uses therein set forth.

Witness my hand and official seal this 13th day of May, A. D. 1895.

[SEAL OF NOTARY.]

MURRAY HANSON,
Notary Public.

And now, to wit, May 13th, 1895, the within bond presented, approved and ordered to be filed.

THOS. J. MORRIS, Judge.

1397 Citation.

UNITED STATES OF AMERICA, }
District of Maryland, } ss :

To the Boyden Power Brake Company ; George A. Boyden, president ; Charles B. Mann, secretary ; William Whitridge, treasurer and Boyden Brake Company :

You are hereby cited and admonished to be and appear at a term of the circuit court of appeals of the United States in and for the fourth circuit, to be holden in the city of Richmond, State of Virginia, at the term of said court, on the 28th day of May, A. D. 1895 ; pursuant to an appeal filed in the clerk's office of the circuit court of the United States, wherein George Westinghouse, Jr., and The Westinghouse Air Brake Company are appellants, and you are the appellees, and show cause, if any there be, why the decree in said appeal mentioned should not be reversed or corrected, as regards so much and such parts of the said decree as contain or involve the refusal of an injunction under claims 1 and 4 of the patent in suit No. 360,070, as referred to in the bill of complaint thereon and speedy justice not be done to the parties in that behalf.

Witness, the Honorable Thomas J. Morris, judge of the said

circuit court of the United States, this 13th day of May, in the year of our Lord one thousand eight hundred and ninety-five.

[The Seal of the Circuit Court, Maryland.]

THOS. J. MORRIS, *Judge.*

Service of the within citation acknowledged this 13th day of May, 1895.

BARTON & WELMER,
Solicitors for Defendant.

1398 Thereupon, it is ordered by the court here that a transcript of the cross-appeal of the complainants in the cause aforesaid, together with all things thereunto relating, be transmitted to the said United States circuit court of appeals for the fourth circuit, and the same is transmitted accordingly.

Test:

JAS. W. CHEW, *Clerk.*

UNITED STATES OF AMERICA, } *To wit:*
District of Maryland, }

I, James W. Chew, clerk of the circuit court of the United States for the fourth circuit, in and for the district of Maryland, do hereby certify that the foregoing is a true transcript of the cross-appeal of the complainants, together with all things thereunto relating in the therein-entitled cause.

In testimony whereof, I hereunto set my hand and affix the seal of the said circuit court this 13th day of May, A. D. 1895.

JAS. W. CHEW,
Clerk of said Circuit Court.

1399 *Proceedings in the United States Circuit Court of Appeals, Fourth Circuit.*

United States Circuit Court of Appeals, Fourth Circuit.

BOYDEN POWER BRAKE COMPANY <i>et al.</i> , Appellants,	} No. 131. Appeal from the Circuit Court of the United States for the District of Maryland.
<i>vs.</i> WESTINGHOUSE AIR BRAKE COMPANY <i>et al.</i> , Appellees.	
WESTINGHOUSE AIR BRAKE COMPANY <i>et al.</i> , Appellants,	} No. 134. Cross-appeal from the Circuit Court of the United States for the District of Mary- land.
<i>vs.</i> BOYDEN POWER BRAKE COMPANY <i>et al.</i> , Appellees.	

April 17, 1895, petition of appellant- in No. 131, affidavit, and order of court thereon relating to filing printed records, was filed, to wit:

109—403

Petition, Affidavit, and Order of Court Relative to Filing Printed Records.

Filed April 17, 1895.

In the United States Circuit Court, District of Maryland.

GEORGE WESTINGHOUSE, JR., and THE WESTINGHOUSE
AIR BRAKE COMPANY

vs.

BOYDEN POWER BRAKE COMPANY; G. A. BOYDEN,
President; C. B. MANN, Secretary; William Whit-
ridge, Treasurer.

In Equity.

To the honorable judges of the U. S. circuit court of appeals, fourth circuit :

In the above-entitled cause a decision was rendered on the 1400 11th day of March by U. S. circuit court, district of Maryland, in favor of the complainants, and, from which decision defendants have appealed.

Under rule 23 of the U. S. circuit court of appeals, the appellant is required to furnish the court with twenty copies of the complete printed record "unless a different order as to such printing is made by the court of its own motion or upon application."

The court is therefore petitioned for an order permitting the defendants—appellants on appeal—to file four copies of the complete printed record with the court. This number will provide each of the three judges with a copy and an additional one in case it is required. The complainants—appellees on appeal—will also be furnished with three copies as required by rule 23.

It is exceedingly important to the defendants that the appeal be heard in the May term, as an injunction has been granted restraining them from manufacturing the device in controversy.

It is impossible to reprint the complainants' record in time for the case to be heard in the May term, as their record consists of over 700 pages, and is extensively illustrated; to do so will require a great deal of time and labor and involve an expenditure of over one thousand dollars (\$1,000).

As the defendants—appellants on appeal—have eight copies of the complainants' record on hand, the record can be made up in time for the May term if the court will grant the desired order. A copy of the order is herewith enclosed.

And as in duty, &c.

SKIPWITH WILMER,
Of Counsel for Appellees.

UNITED STATES OF AMERICA, }
District of Maryland, } *To wit :*

Before the subscriber, a commissioner of the United States, in and for the district of Maryland, personally appeared in the said district

his 13th day of April, in the year eighteen hundred and ninety-five, George A. Boyden, president of the Boyden Brake Company of Baltimore City, and made oath on the Holy Evangelical of Almighty God that the matters and things stated in the foregoing petition are as therein set forth, to the best of his knowledge, information and belief, and subscribed the same.

G. A. BOYDEN.

[SEAL.] GEORGE MORRIS BOND,
United States Commissioner for the
District of Maryland.

1401 Ordered by this court this 17th day of April in the year eighteen hundred and ninety-five, on the foregoing petition and affidavit that the appellants be, and they are hereby permitted and authorized to file with the clerk four copies of the record for the use of the court and three for the use of counsel for the appellees, instead of twenty copies as required by rule 23, as prayed in the said petition.

N. GOFF.

May 7, 1895, the transcript of the record in No. 131 and six copies of the printed record was filed, and appearances of Skipwith Wilmer, Hector T. Fenton, and Lysander Hill were entered for the appellants.

May 9, 1895, appearances of Bernard Carter, J. Snowden Bell, and George H. Christy were entered for the appellees in No. 131.

May 14, 1895, the transcript of the record on cross-appeal (No. 134) was filed, and appearances of J. Snowden Bell, George H. Christy, and Bernard Carter were entered for the appellants.

May 16, 1895, appearances of Barton & Wilmer, Lysander Hill, and Hector T. Fenton were entered for the appellees in No. 134.

May 16, 1895, 16 copies of the printed record, together with the following petition of the appellants, were filed in No. 134.

Petition to file printed records on cross-appeal *nunc pro tunc* as of May 7, 1895.

Motion to File Record on Cross-appeal Nunc pro Tunc.

Filed May 16, 1895.

U. S. Circuit Court of Appeals, Fourth Circuit.

GEORGE WESTINGHOUSE, JR., and THE WEST-
INGHOUSE AIR BRAKE COMPANY

vs.

BOYDEN POWER BRAKE CO., GEORGE A. BOY-
den, Charles B. Mann, William Whitridge,
and Boyden Brake Co.

In Equity. No. 134.

1402 And now, to wit, May 16th, 1895, the complainants above named file this their motion that the printed records of their cross-appeal, filed herewith, may be ordered to be filed *nunc pro tunc*, as of May 7th, 1895,—to the end that both appeals may

come on together regularly for hearing under the rules—this motion being based on the following, among other facts:

1st. Decree was not entered till April 25th, 1895.

2nd. Original appeal was not taken until April 29th, 1895.

3rd. Complainants' counsel were not advised of any intention that the hearing thereof would be urged for the coming term, until they were served with the printed records, the latter though served formally on May 8th, not reaching them until May 10th.

4th. During the week next following the original appeal, complainants' counsel were necessarily engaged in preparing and arguing in the U. S. circuit court of appeals for the second circuit the appeal taken by the defendants from the decree of Judge Lacombe granting an injunction in *Westinghouse et al. v. New York Air Brake Company et al.* for infringement, *inter alia*, of the patent here in suit.

For these reasons, the delay was unavoidable, and this motion is made accordingly.

GEORGE H. CHRISTY,

For Complainants.

June 8, 1895, motion of appellees in open court in No. 134 to dismiss the cross-appeal.

June 10, 1895, motion of appellees in No. 134 to dismiss the cross-appeal was argued, and the motion was denied.

June 10, 1895 (May term, 1895), both causes came on to be heard on the transcripts of the record from the circuit court of the United States for the district of Maryland, and were argued together by counsel, and submitted.

At the November term, 1895, to wit: November 11, 1895, the court announced and filed its opinion, which is as follows, to wit:

Opinion.

United States Circuit Court of Appeals, Fourth Circuit.

BOYDEN POWER BRAKE COMPANY <i>et al.</i> , Appellants, <i>vs.</i> WESTINGHOUSE AIR BRAKE COMPANY <i>et al.</i> , Appellees.	}	No. 131. Appeal from the Circuit Court of the United States for the District of Maryland.
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WESTINGHOUSE AIR BRAKE COMPANY <i>et al.</i> , Appellants, <i>vs.</i> BOYDEN POWER BRAKE COMPANY <i>et al.</i> , Appellees.	}	No. 134. Cross - appeal from the Circuit Court of the United States for the District of Mary- land.
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(Causes argued together June 10, 1895.
Decided November 11, 1895.)

Before Goff and Simonton, circuit judges, and Hughes, district
judge.

Lysander Hill, Hector T. Fenton, for the Boyden Power Brake
Company, Skipwith Wilmer on the brief; George H. Christy,
Frederick H. Betts, for Westinghouse Air Brake Company, J.
Snowden Bell and Bernard Carter & Son on the brief.

Statement.

George Westinghouse, Jr., one of the complainants in this suit,
is the inventor of automatic air brakes for the slowing and stopping
of railroad trains. He has taken out patents for devices in this
connection to the number of some ten or twelve. Of these, the
patent now in suit is that numbered 360,970, issued March 29, 1887.

This device does not seem to have proved effectual for the
1404 special purposes for which it was designed, and he improved
it by a later one, patented to him on January 24, 1888, num-
bered 376,837, which is not in suit. These two devices, while pre-
serving the mechanism for the ordinary stopping of trains em-
braced in earlier patents, contained additional mechanism for their
prompt and complete stoppage in sudden emergencies. The ap-
paratus as thus devised and improved are technically called quick-
action brakes, and are embraced in the patents 360,970 and 376,837.

Of the air brakes patented by Westinghouse previously to the
issuing of the two patents just named, the latest improvements were
embraced in the patent numbered 220,556, issued October 14, 1879.
In speaking of this latter patent we shall, except when special men-
tion of previous ones will be necessary, include generically all the
improvements embodied severally in its predecessors. This air
brake 220,556, though intended for both ordinary work and emer-

gency work, proved to be really effective only for the ordinary slowing and stopping of trains, and not to answer for the sudden stoppage of very long trains of cars. But it contained the auxiliary reservoirs and other apparatus which gave the brakes an automatic action. These three patents, numbers 220,556, 360,070 and 376,837, are those which enter most directly into the consideration of the case before us.

It is true that the patent of Westinghouse, number 168,359, is mentioned in complainants' bill of complaint, and not number 220,556; but in the briefs and in most of the testimony number 220,556 is made the prominent subject of discussion, and not number 168,359. There was an intermediate patent, number 217,838, which enters more or less into the polemics of this controversy; inasmuch as that patent, as well as number 220,556, already mentioned, were the immediate bases on which the quick-action brake, number 360,070 was founded.

In the earlier stages of the development of the Westinghouse air brake, it consisted of the following parts: First, a compressing air pump on the engine by which air was compressed to the density of eighty pounds to the square inch; second, a large reservoir for storing the compressed air fixed on the engine; third, a train-pipe or main pipe leading from the engine to and along all the cars of the train, connected at each interval between the cars by a flexible hose with couplings rendering the train-pipe continuous and constituting it a conduit for transmitting compressed air from the engine to every car; and fourth, a brake-cylinder on each car, connected by a branch pipe to the train-pipe, and chargeable with
1405 compressed air through the train-pipe from the storage reservoir on the engine—this brake-cylinder operating, by means of suitable levers, upon the brake-shoes which clasped the wheels of each car.

Useful as this system of braking proved to be, it was found not to meet all the requirements of the service. In the transmission of compressed air from the engine an appreciable loss of time was found to occur. This loss proved to be about one second per car; so that on a passenger train of ten cars the time necessary for the pressure to reach the rear car would be ten seconds; and on a freight train of fifty cars would be nearly a minute. Thus, while the forward movement of the foremost cars would be checked at once, that of the rearmost cars would not be as promptly checked, and these would come against the cars in front of them with more or less shock, producing more or less discomfort or positive damage. This defect will be appreciated when it is remembered that a train moving at the rate of forty-five miles an hour moves sixty-six feet per second; so that, a freight train of fifty cars would run more than half a mile before the brakes could begin to be effective along the entire train. This defective system contained but one reservoir for holding the compressed air, which, as before stated, was attached to the engine, and from which all the brake-cylinders of the several cars had to be charged back through the train-pipe and its branches and couplings.

It was incumbent upon the inventor, therefore, to devise a remedy for this defect in the earliest forms of his air brakes. He supplied it by providing an auxiliary reservoir for compressed air on each car; and also by devising a mechanism for discharging compressed air from this auxiliary reservoir into the brake-cylinder of its own car; so that as soon as the engineer put in action his mechanism for checking or stopping the train, there was a more nearly simultaneous action of the brake-cylinders along the whole train upon the series of brakes provided for each car.

The mechanism devised for this purpose was what is known in the art as the triple valve; one of which was provided for each car, and acted upon each brake-cylinder with compressed air drawn from each auxiliary reservoir. It was called a triple valve because one of its valves controlled the passage between the train-pipe leading from the engine and the auxiliary reservoir; another between the auxiliary reservoir and brake-cylinder belonging to each car, and a third between the brake-cylinder of each car and the atmosphere. It was located at the junction of the three pipes which lead from and to each of these devices. The triple valve has three ports leading, respectively, to the three devices named, and also a fourth one leading to the open air.

1406 A very important feature of the Westinghouse triple-valve mechanism consisted in its being automatic in operation. It is not in our province to enter into details, suffice it to say that when the train is in use all the apparatus which has been described is kept constantly charged in full with compressed air generally to the density of seventy pounds to the inch, which has continuous and unobstructed flow from the main reservoir on the engine to all the auxiliary reservoirs on the cars. While the apparatus is thus full charged from the engine, through the train-pipe to the auxiliary reservoirs, the piston of each triple valve is held to its normal position with the port between the auxiliary reservoir and brake-cylinder closed, there being an equipoise of pressure on each side of it. It follows that whenever the pressure of the air on the train-pipe side of the piston is reduced, the piston moves out into its chamber and thereby opens a passage for the compressed air from each auxiliary reservoir into each brake-cylinder, resulting automatically in an application of the brakes. This reduction of pressure in the train-pipe has the result described, whether it is caused by the engineer in intentionally opening his valve for the purpose, or by an accident which may produce a rupture in any part of the train-pipe. Such action of the engineer, or such accident, opens the train-pipe for the escape of pressure from that side of each triple-valve piston, causes the piston to move forward in its chamber, and thereby to open a passage for discharging compressed air from the auxiliary reservoir to the brake cylinder for action upon the brakes. This *automatic* action was a very important achievement, and gave to the air brake of Westinghouse a part of its name.

Before this invention the brake-cylinders were charged directly from the engine by forcing the compressed air backward into them, along the entire length of the train. In the triple-valve device the

air movement was reversed. While the train is running, all the apparatus, except the brake-cylinders, is full of air of the density of seventy pounds, stored distributively in the several auxiliary reservoirs. The engineer operates by opening his valve on the engine for the escape of train-pipe air, which thereby takes a course the reverse of the former, from the rearmost car and moving forward along all the cars to its escape at the engineers' valve.

Thus before the invention of the improved device patented in No. 217,838, when the engineer desired to apply his brakes with full force, he operated the valve at the engine and opened the port wide, letting the compressed air out of the train-pipe at the 1407 locomotive, then its only vent. The air, as before said, had to travel from the rear car along all the cars, forward to the engine, before it could lessen the pressure of the train-pipe air on the train-pipe side of the chamber of each triple-valve piston, and before the brake-cylinders could be operated with air from the auxiliary reservoirs. In a train of fifty cars it would have to travel nearly half a mile to get out at the engine. Westinghouse devised in patent 217,838 a means of quickly emptying the train-pipe by providing release valves on each car connected directly with the train-pipe; so that the air of the train-pipe could be vented promptly at each car, and thus shorten the time of bringing all the brakes along the whole train into action.

But while the triple valve and other mechanism patented in number 217,838 and number 220,556 was intended to accomplish the purpose of producing simultaneous action by the brakes in every car, and thus to prevent, in a great measure, the jostling of cars against each other, thereby securing a comparatively steady, smooth, uniform arrest of movement along the whole train; yet it was found to be effective for this purpose in very long freight trains only on ordinary occasions, such as the stopping of trains at stations, or slowing them at side tracks, or holding their speed in check on descending grades. The mechanism of the patents just named did not provide effectively for sudden emergencies, and therefore failed to meet a great necessity of the service.

It is true that the design of the inventor was to devise in these patents an apparatus that would be effective for both the gradual and the sudden stoppage of trains. For the former purpose he inserted a sensitive valve on the stem of the triple-valve piston of 220,556 by which, on a partial movement of the piston in its chamber, a graduated discharge of air from the auxiliary reservoir into the brake-cylinder was effected. For the latter purpose, the sudden stoppage of trains, he provided a main valve at the end of the stem of the piston by which, on a complete traverse by the triple-valve piston in its chamber, a large venting of compressed air from the auxiliary reservoir was effected, so that, in the language of one of the Westinghouse witnesses, "if an emergency arises demanding that the brakes be instantly applied with full force to effect a sudden stoppage of the train, the pressure of air is suddenly and considerably or entirely reduced in the train-pipe with the result that the piston of the triple valve makes its full stroke, * * * per-

mitting auxiliary reservoir air to flow directly into the brake-cylinder, * * * (making what is known as) the emergency stop."

1408 The inventor, however, failed in this latter object. It was found in practice on long trains that the air from the auxiliary reservoir did not act with sufficient promptitude on the brakes of the rear cars for emergency purposes, and that it would be necessary to devise some other means for effecting a quick action of the brake-cylinder. Patent 168,359, repeated in patent 220,556, was a most valuable invention. It had great utility. It produced a uniform stoppage of the cars of long trains on ordinary occasions, and on short trains, whether passenger or freight, it was practically effective even for emergency purposes. Yet for the sudden stoppage of long trains in the face of immediate danger it failed to answer the requirements of the service. As one of the counsel of Westinghouse expressed it in his oral argument before this court: "A passenger train or a freight train of moderate length, and, therefore, of moderate weight, could be stopped, as is shown by the proofs, by the old automatic brake (patent 220,556) within reasonable limits of distance of space and lapse of time; but the railroad conditions of the country and the system of traffic altering, by which large locomotives drawing heavy and long trains came into use, a new development in the art was called for; that is, for a brake which would act quicker on any car, and act quicker from car to car, than any which had previously existed."

With this brake of patent 220,556, gradual stopping and slowing was executed by giving the piston a partial or half traverse on its chamber by which air passed through the sensitive valve on the stem of the piston to the brake-cylinder; and emergency stopping was done by a full or extreme traverse of the piston in its chamber which closed the sensitive valve in its stem and opened the main valve fixed upon the end of the stem, and allowed a full and direct venting of air from the auxiliary reservoir into the brake-cylinder. The best illustrations available for the better understanding of the preceding remarks are the diagrams that are found opposite pages 20 and 21 of the main brief of the appellants. (Boyden.)

It is obvious from what has been said that the piston of the triple valves is a most prominent instrumentality in the present controversy. The brakes are operated by the engineer from the engine. The engineer's duty in connection with them is, first, to keep his apparatus full charged with compressed air whenever the train is in use, and, second, when the occasion requires, to let off air from the train-pipe, and thereby cause, in the manner heretofore described, the escape of more or less air from the auxiliary reservoirs into the brake-cylinders for action upon the brakes. The

1409 mechanism is such, also, as before stated, that an escape of compressed air from the train-pipe results not merely from the intentional action of the engineer himself, but automatically from any accident that may happen to cause a severance of the train into parts, or a rupture of the train-pipe or its connecting hose or branches. It is the escape or venting of compressed air,

either intentional or accidental, from the auxiliary reservoirs in which it is stored, into the brake-cylinders, that operates the brakes and this venting is done through the triple valves by means, as heretofore stated, of the triple-valve pistons.

In the Westinghouse automatic air brake, as patented in number 220,556, the ordinary work of braking was performed by a partial traverse of its chamber by triple-valve piston, graduated, according to the purpose desired, at the will of the engineer; and emergency work was done by an extreme traverse of the piston to the end of its chamber. It may be observed that the automatic air brake patented as number 220,556, which embraced all previous improvements, is now free to public use, the patent having expired and ceased to be confined to the exclusive use of its inventor.

A study of patent 220,556 will show that compressed air driven by the engineer into the train-pipe, passed through the triple valve of each car to its auxiliary reservoir; that there was no vent from this train-pipe air into the brake-cylinder, except through the auxiliary reservoir, and that this vent from the auxiliary reservoir to the brake-cylinder ordinarily occurred when the triple-valve piston had made but a partial movement or traverse in its chamber. The text and diagram of 220,556 show that even a full or extreme traverse of the piston in its chamber would vent no other compressed air into the brake-cylinders, except from the auxiliary reservoirs.

The device embraced in patent 220,556, valuable and efficient as it is and was for ordinary work on all trains, with the triple-valve piston in partial traverse, and for emergency work on short trains with the triple-valve piston in extreme traverse; yet it failed to meet the requirements of the service for emergency work on long trains of fifty large freight cars. For the latter work it was found insufficient in practice, the insufficiency consisting in not acting with sufficient promptitude. It is not for us to explain why the passage of compressed air exclusively from the auxiliary reservoir to the brake-cylinders was not sufficiently prompt on long freight trains. It is assumed in the briefs and testimony that the mechanism of this patent did not suffice for this work. It is admitted on both sides that while the mechanism of 220,556, though effective for the ordinary purposes of braking trains such as stopping them at stations, slowing them in passing switches and other points requiring continuous movement, and checking them on descending grades, yet that it was not effective for abruptly stopping long trains in sudden emergencies.

This deficiency of the Westinghouse brake in the stage of improvement which it had reached in patent 220,556, from whatever cause resulting, created the necessity for some additional invention by which, on sudden emergencies in the presence of immediate danger, a long train of cars in rapid motion should be immediately brought to an abrupt stoppage by an instantaneous and simultaneous application of all the brakes of every car. The thing wanted was what has technically come to be called "quick action."

Each of the chief contestants in the present suit set himself laudably to work in deriving a means to accomplish this important

desideratum, each taking the air brake, patented as number 220,556, Westinghouse's exclusive property in which has expired, as the basis of his new device, the common object being to produce a mechanism by which to secure instantaneously, whenever and only when a sudden emergency arose, such a quickened discharge of compressed air into the several brake-cylinders that each car would simultaneously, and the entire train as a whole, be brought to a sudden halt, but leaving all the mechanism already existing for use in ordinary braking unmolested and unchanged.

Counsel for appellees (Westinghouse) in his oral argument well described the need that was to be supplied when he said: "Quick action does not involve greater *power* of the brake; it is not a question of greater force of brake, as applied to the brake-shoes of any individual car. The force with which the brak'-shoes are applied to any individual car is no greater with the Westinghouse quick-action brake (360,070), which is in controversy here, than it was with the old automatic brake (220,556). The engineer is, in both cases, operating with seventy pounds of pressure in the main reservoir on the locomotive and in the auxiliary reservoirs on the cars throughout the train, and in the system of pipes throughout the train, and all the force he can possibly apply with the present quick-action brake (360,070), or with the old automatic brake (220,556), is seventy pounds of pressure to the piston of the brake-cylinder, and through it to the brake-shoes."

And the same counsel well described the desideratum sought for—the gist of the urgent need—when he said that its characteristic must be "the utilization of auxiliary reservoir pressure for service or for graduation, when you do not need to use quick action; but when you want to get what is known in the art as *quick-action*, when the question of life or death is to be settled in a few seconds, then the pressure from the *train-pipe*, (which comes from the main reservoir on the locomotive,) is to be utilized for that purpose."

Westinghouse devised for each car an additional valve, which he so attached to the triple valve of patent 220,556 that when the piston should be in complete traverse and driven to the end of its chamber, it should drive forward an additional stem provided for this additional valve, and thereby open a port in that valve by which compressed air from the train-pipe should pass, through by-passes independent of the triple valve, into the brake-cylinder into which the triple valve vented compressed air from the auxiliary reservoir. By this device of the additional stem, the additional valve and the independent by-passes into which the latter opened, the inventor contrived to discharge compressed air from both the auxiliary reservoir and the train-pipe into the brake-cylinder of each car simultaneously, and thereby so quickened the action of the brakes as to accomplish the desideratum of *quick action*. To repeat, his device for this purpose consisting in attaching to the pre-existing triple valve, as patented in number 220,556, a machine which embraced an additional stem, an additional valve and additional air passages leading from the port in the new valve to the brake-cylinder. This

new attachment is put into action for emergency purposes by the triple-valve piston when on its extreme transverse. The previous machine 220,556 had provided for the extreme traverse of the piston by which it had put in action the main valve at the end of its old stem, and opened a full and direct flow of compressed air from the auxiliary reservoir into the brake-cylinder for the use in emergencies. Thus the new contrivance, by the same extreme traverse of the triple-valve piston, continued the old flow of compressed air for emergency purposes and provided an additional flow of the air for emergency purposes by an additional mechanism; the latter flow being directly from the train-pipe, and the former flow being from the auxiliary reservoir. Such was the make-up of patent 360,070—two machines in one box or case. It was found, on thorough and conspicuous trials, to be imperfect and inefficient, and lacked that essential element of patented devices—utility. But it contained a valuable invention, and was afterwards to improved details, when patented in number 376,837, as to become 1412 machine of great value to the public, a supplemental piston being supplied in 376,837.

Boyden also made a successful invention of venting compressed air from the train-pipe into the brake-cylinder of each car simultaneously with venting air from the auxiliary reservoir to the brake-cylinder, as had been done for emergency purposes by the previous triple valve of patent 220,556. He did not resort to a second machine. He — not devise an additional stem, an additional valve or by-passages independent of those of the triple valve. He accomplished the transmission of compressed air directly from the train-pipe to the brake-cylinder by other means. He inserted a partition in the form of a brass ring into the triple valve of patent 220,556 itself, between the chamber containing the valves and the compressed air of the auxiliary reservoir on one hand and the chamber of the piston containing train-pipe air on the other, and he opened a port in that partition for the passage of compressed air from the train-pipe to the brake-cylinder. He thereby so provided that where Westinghouse's device employed a fourth valve, another stem and newly contrived by-passages for discharging compressed air from the train-pipe into the brake-cylinder, organized separately in a second machine; Boyden contrived to discharge both train-pipe and auxiliary reservoir air simultaneously into the brake-cylinder without using an additional stem or valve or by-passages. The devices of Westinghouse and Boyden are exhibited by the diagram on the sheet inserted between pages 34 and 35 of appellant's (Boyden) principal brief, and is attached to this statement. Let these diagrams be made a part of this opinion.

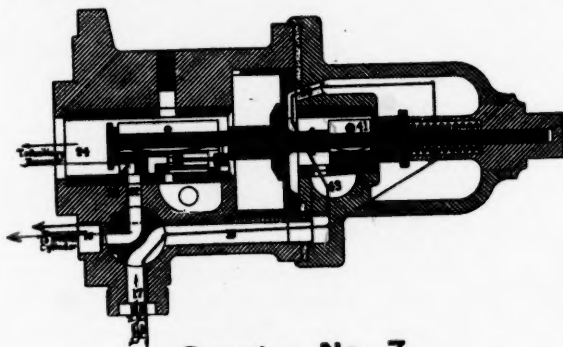
(Here follow diagrams marked pp. 1413 & 1414.)

It is not for us to describe how the introduction of train-pipe air into the brake-cylinder of each car quickens the action of the brakes which are already subject to the action of air from the auxiliary reservoir. It is sufficient to say that the engineer, by means of

No. 403 & 426 }
 Westinghouse Co. } p. 1413
 Royden Co.

To face page 14

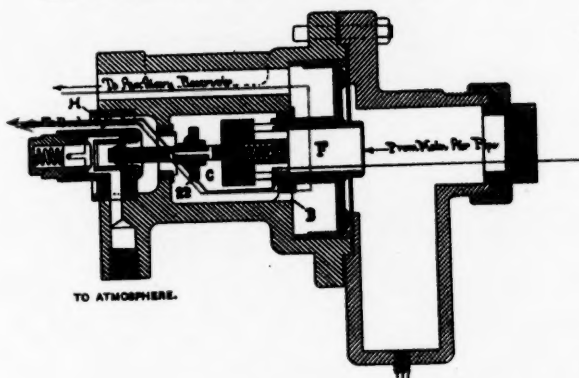
Complainant's Patent No. 360,070.



Drawing No. 7.

NOTE.—The Check-Valve 49 is located back of the passage 18 and therefore is not visible on Cut 7.

Defendant's Structure Plate XI.

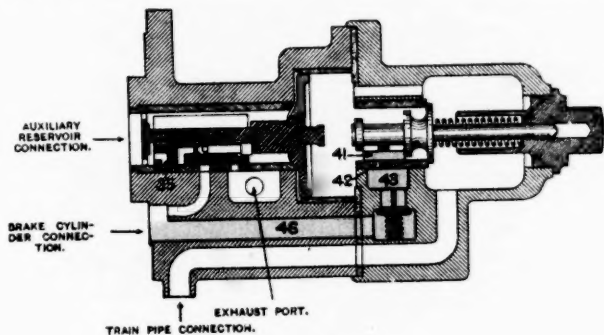


Drawing No. 8

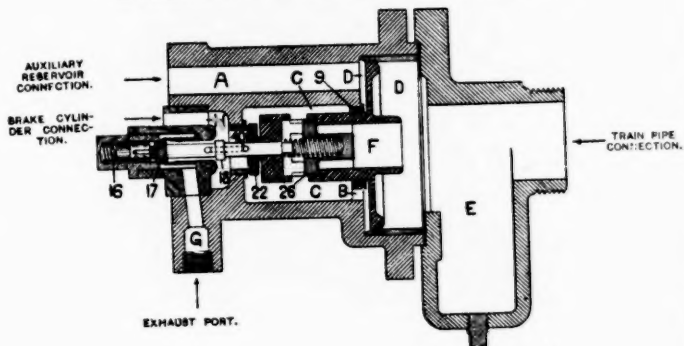


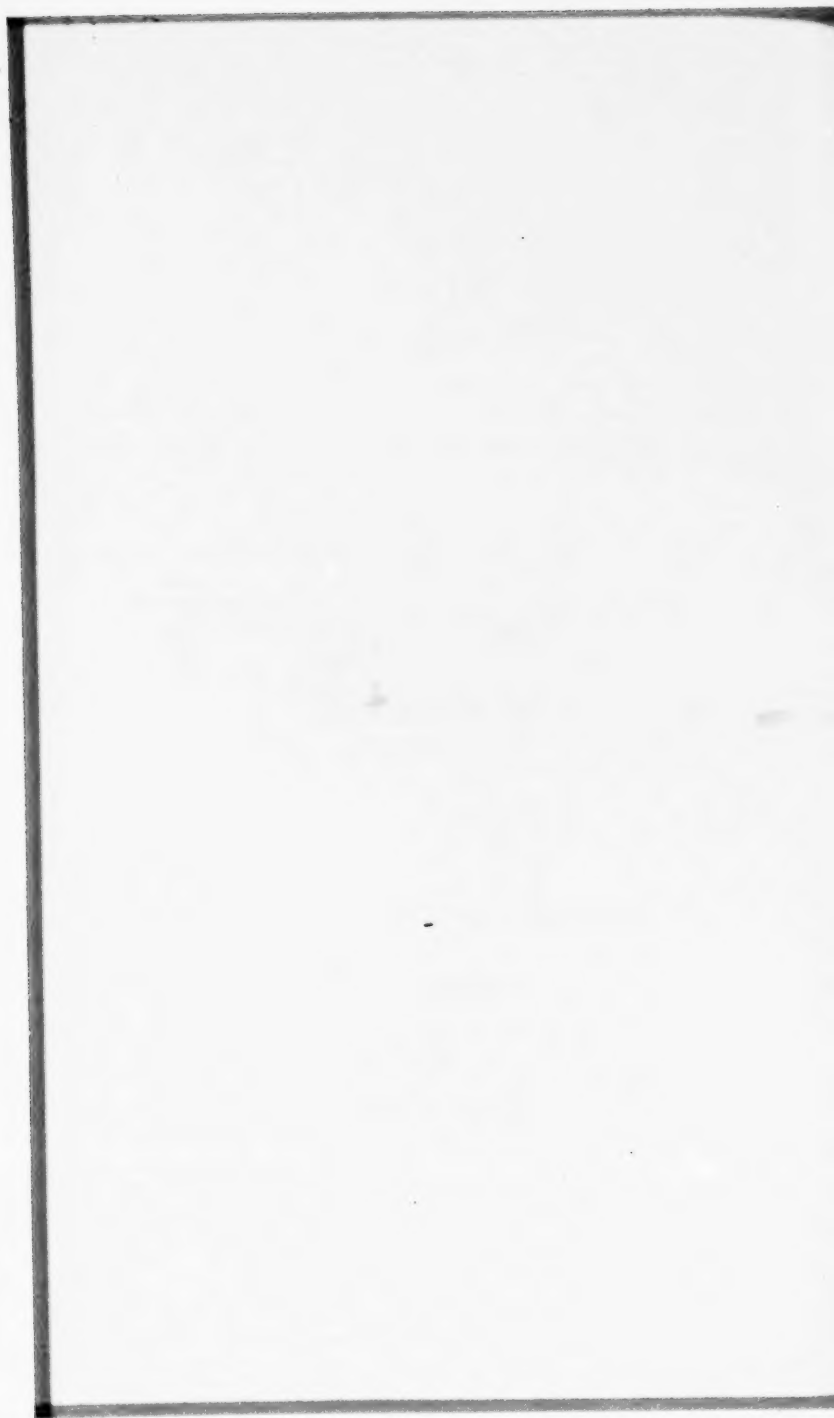
*Mos. 403 + 426.
Westinghouse Co. } p. 1414
v.
Dwyer Co.*

Complainant's Patent in Suit, No. 360,070.



Defendant's Structure, Plate XI.





valve on the engine and by means of the branch pipe leading from the train-pipe to the triple valve of each car, can, by the improvements in controversy, vent the air of the train-pipe directly and more promptly into the brake-cylinder, and thus more quickly apply the brakes, than he can by the indirect conduit opened by the main valve of 220,556 into the brake-cylinder from the auxiliary reservoir when its piston is in extreme traverse, as heretofore described. Quick action being the desideratum, the engineer effects it more promptly by the direct means than by the indirect.

1415

Opinion.

HUGHES, J. :

The foregoing statement of facts and explanation of the devices upon which the decision of this case depends is of unusual length, which has been a necessary result of the extraordinary magnitude of the record and the unusual number and volume of the briefs of counsel in the case ; but it has been prepared at the expense of very much labor, and is, we trust, *we trust*, sufficiently correct to warrant the conclusions of law of which we have founded upon them.

Of the technical "claims" set out by Westinghouse in his application for the patent, number 360,070, those numbered 1, 2 and 4 are the special subjects of this suit. The device described in these claims is the one which Westinghouse charges in the bill of complaint in this case to have been infringed by the Boyden invention. The three "claims" are as follows, and the words in italics indicate the device charged to have been infringed :

" 1. In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake-cylinder, a triple valve, and an *auxiliary-valve device, actuated by the piston of the triple valve and independent of the main valve thereof, for admitting air in the application of the brake, directly from the main air pipe to the brake-cylinder, substantially as set forth.*

" 2. In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake-cylinder, and a triple valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake-cylinder, *and which by a further traverse admits air directly from the main air pipe to the brake-cylinder, substantially as set forth.*

" 4. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston-stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere, respectively, *and an auxiliary valve actuated by the piston stem and controlling communication between passages leading to connections with a main air pipe and with the brake cylinder, respectively, substantially as set forth.*"

The phrase "substantially as set forth" is technical, and is equivalent to saying "by the means described in the text of the in-

ventor's application for letters patent, as illustrated by the
 1416 drawings, diagrams, and models which accompany the application." These words limit the general terms of the specification which set out the *function* performed by the invention, and confine the inventor's rights to his own *means* or their mechanical equivalent of performing the function.

It is unnecessary to set in *totidem verbis* the technical "claims" in which Boyden summarized his application to the Patent Office. Suffice it to say, that his device, original and improved, which is represented in the patents issued to him as numbers 481,134, 481,135, and 481,136, dated August 16, 1892, provided for the admission by a single valve, integral with the triple valve, of both train-pipe air and auxiliary reservoir air to the brake-cylinder for emergency stops. He accomplished this object as Westinghouse did, by a device acted upon by the triple-valve piston when at the same extreme traverse at which it had been previously used for emergency work. As to using this extreme traverse, described in the patent which expired, number 220,556, he did what Westinghouse did; but the object of either being the discharge of train-pipe air into the brake-cylinder (which was new) simultaneously with the discharge of auxiliary reservoir air into that cylinder (which was old), Boyden invented a partitioning ring in the old triple valve to divide the chamber of the three valves from the chamber of the piston, and opened in this ring a port through which the train-pipe air might pass from the piston chamber through the chamber of the valves to the brake-cylinder; while Westinghouse attached an additional individual machine to patent 220,556, consisting of a stem moved by the main piston in extreme traverse, an additional valve, and additional independent by-passages leading from the additional valve to the brake-cylinder. The same *result* was accomplished by the two devices, but these had but one means in common. Each used one common mechanical movement of the main piston, which was a movement described in the patent which has expired. But the further mechanism employed, respectively, by the two inventions were, respectively, as has been described.

The transmission of train-pipe air and auxiliary reservoir air simultaneously to the brake-cylinder is a *result* of function and is not patentable. The *means* by which this or any other result or function is accomplished may be many and various, and if these several means are not mechanical equivalents, each of them is patentable. The question at bar is, whether Boyden's brass-ring partition with the port it contains, inserted in and made a part
 of the triple valve itself, successfully accomplishing the
 1417 function of discharging train-pipe air into the brake-cylinder simultaneously with the triple valve's discharge of auxiliary reservoir air into that cylinder, is the mechanical equivalent of Westinghouse's attached machine, non-integral, segregate and individual, consisting of another stem, another valve, and by-passages peculiar to itself leading from the additional valve to the brake-cylinder; both devices being put in action by the triple-valve piston when on its old extreme traverse.

This question was presented necessarily to the Patent Office of the United States when Boyden applied for a patent for the device under consideration. That office employs the best experts in mechanics which it can secure in this and other countries. Its examinations are indeed *ex parte* in form, but they are, nevertheless, conducted under hot and skilled contestation in every case of importance, and its decisions, though not conclusive, are entitled to great respect. That office, after full examination, awarded a patent to Boyden on the 16th day of August, 1892, for his quick-action improvement on the device of patent 220,556, and that action by the office was, in effect, a ruling that the Boyden device did not infringe Westinghouse's quick-action patent number 360,070. That ruling takes rank here as the testimony of experts of the highest experience, skill and knowledge in mechanics. That ruling was subsequent to the issuing to Westinghouse of both the patents, numbers 360,070 and 376,837, four years after the latter patent, when the Patent Office had full knowledge of them.

The circuit — held, in its decision of this case, that the Boyden device was the functional equivalent of that of Westinghouse, as described in claim 2 of patent 360,070; that both devices depended upon the extreme traverse of the triple-valve piston of patent 220,556, and that this traverse was new and unusual. It held virtually that the novelty of this extreme traverse, on which both the quick-action devices of the two inventions depended, and their functional equivalency made Boyden's device an infringement of Westinghouse's. That the mechanism of Boyden differed from that of Westinghouse, so far as the mechanical means which was used in availing of the extreme traverse was concerned, does not seem to have been controverted by the circuit court. But it held, virtually, that because the extreme traverse was new and was a pioneer invention of Westinghouse and was necessary to put both of the two devices into action, and because the means devised for utilizing the extreme traverse in emergency work were functional equivalents of Westinghouse's: therefore Boyden's device was an infringement.

1418 It is obvious to us that the circuit court erred in interpreting the patent in suit by imputing novelty to the extreme traverse of the triple-valve piston, because this was shown in the prior patent 220,556 and its predecessor, 168,359. That machine, 220,556, was designed both for graduated braking and for emergency braking. The former was provided in the sensitive valve inserted in the stem of the triple-valve piston, through which compressed air was vented, in quantity graduated at the will of the engineer, from the auxiliary reservoir into the brake-cylinder. But this earlier and expired patent contained more than the sensitive valve in the stem of the piston, and more room in the piston chamber than was necessary for a partial traverse of the piston. It contained a main valve and a sufficient prolongation of the piston chamber for the extreme traverse. This main valve and this prolongation of the chamber were entirely useless for graduated work, and was intended and employable only for emergency work. The

main valve would not have been contrived nor the chamber prolonged except for the purpose, by giving the piston its extreme traverse in the extended chamber, and thus bringing the main valve into action, of fitting it for emergency work. The machine patented as Nos. 168,359 and 220,556 did good emergency work in short trains, and the extreme traverse of the piston was constantly employed in that work; and this employment of it was not "unusual." But in long trains, and especially in long trains of heavy freight cars, it failed to do emergency work with sufficient quickness. The emergency apparatus, however, was there, to wit: the main valve and the extended chamber. They had been patented, and the patent has expired. The extreme traverse of the piston in its extended chamber for emergency use, was as old as the expired patent, No. 220,556. The circuit court, therefore, erred in supposing and ruling that it was new and unusual.

As there was no novelty in the extreme traverse of the old triple-valve piston it must be eliminated from consideration, and the mechanical equivalency of Boyden's device of the partitioning ring integral with the triple valve itself on one hand, and on the other hand the Westinghouse device attached to the triple valve, and consisting wholly of apparatus not integral, but segregate, individual, several, additional to and independent of it—depends upon the character of the two devices themselves, considered and compared apart from the extreme traverse, and not upon their being put into action by the extreme traverse of the triple-valve piston. Comparing the two devices apart from the triple-valve piston in 1419 extreme traverse, we are unable to entertain a doubt that the ruling of the Patent Office was correct to the effect that Boyden's device was not the mechanical equivalent of that of Westinghouse. They seem to us to differ as widely from each other as two devices for accomplishing the same result can well differ.

We think that when claim 2 of 360,070, in its language describing the action of that device, failed to describe any means by which the extreme traverse of the piston produced it, declaring merely that the piston, "by a further traverse, admits air directly from the main air pipe to the brake-cylinder," it was fatally defective, claiming only a result which is public property and not identifying the specific means (his own property) by which the result is achieved.

That this invention of Westinghouse, thus undefined, is one of the highest value to the public, and that — is a pioneer one in the art of quick-action air-brakes is not denied, and is conceded. It is conspicuously one of those pioneer inventions which entitle the proprietor to a liberal protection from the courts in construing the claim. But there is a limit to the judicial liberality in this direction. If an inventor is ambiguous or obscure, or halt or limp in his language of description, the courts will help him out and so construe the claim as to give distinct identity to his device. If there be a doubt in the mind of the court or of a jury on the issue of mechanical equivalency, the court will give, and instruct the jury to give, the benefit of the doubt to the pioneer inventor. But where the inventor falls so far short in his description as to claim only the

result which his machine accomplishes, and omits an explicit definition of the *means* by which he does it, as in the case at bar, the courts have another duty to perform, one which they owe to the public and to the worthy fraternity of inventors, and must decline to give him general rights where he is entitled only to special rights.

The inventor in the present case seemed himself to feel that his claim was too broad in terms. In his original application for patent 360,070 his first claim was couched in this language: "In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake-cylinder, and a triple valve provided with a device for admitting air directly from the main air pipe to the brake-cylinder." This language covered *any device* which might accomplish the object mentioned, and he found it necessary to erase it from his specification, and to substitute claim 1 as it now stands.

In the same specification Westinghouse had also used this language: "Further, while in the specific construction described and shown, the function of admitting air from the main pipe is performed by a valve *separate* from that which effects the preliminary admission of reservoir pressure to the cylinder, a modification in which the same office is performed by a valve *integral* with the main valve and formed by an extension thereof, would be included in and embody the essential operative features of my invention." Here again was a claim for a function irrespective of the mechanical means used in accomplishing it, which the inventor found it necessary to erase from his specification. In the suit at bar he virtually asks the court to restore to his claim the two erasures which he felt himself unable to sustain at the Patent Office. Our duty to the public and to inventors at large forbids our doing so.

Some notice is proper, in this connection, of the contention of appellees (Westinghouse), that the additional valve, four, in the additional stem of the quick-action apparatus attached to the original triple valve 220,556, by Westinghouse in patent 360,070, is the mechanical equivalent of the poppet valve of Boyden which he designates as 22 in the triple valve of 220,556 as he improves it in his device. This contention is urged on the ground, as alleged, that Boyden makes it perform the same purpose which Westinghouse's fourth valve performs in his attached apparatus. But Boyden simply substituted in the original triple valve his poppet valve 22 for the slide-valve which is the main valve of patent 220,556. Boyden's is not an "auxiliary" valve; it is mechanically the original main valve of the original triple valve, and it performs the service which is performed by the main valve of 220,556. It is not the mechanical equivalent of valve four in the attached apparatus of Westinghouse simply by reason of its taking part in an emergency service in admitting train-pipe air into the brake-cylinder. In the original triple valve it performed no other service than admitting auxiliary reservoir air into the brake-cylinder; in Boyden's device it continues to perform that service, and is made incidentally instrumental in allowing the passage of train-pipe air. The performance incidentally of quick-action service does not make it an auxiliary valve. It

is the same valve. The incidental *service* is auxiliary, but the valve itself is the same and unchanged. We think the circuit court was correct in its view that the poppet valve 22 of Boyden is the original main valve of 220,556.

We think the circuit court was correct in ruling that Boyden's invention under consideration does not infringe claim 1 of Westinghouse. The language of that claim, in defining the additional apparatus of Westinghouse embraced in patent 1421 360,070, is, "and an auxiliary-valve device, actuated by the piston of the triple valve and independent of the main valve" for admitting air directly from the train-pipe to the brake-cylinder. Obviously there is no "auxiliary valve" "independent of the main valve" in the Boyden device, and, we think, the ruling was correct. The case is similar in respect to claim 4 of Westinghouse. The language there is, "and an auxiliary valve actuated by the piston stem and controlling communication between passages leading to connections with a main air pipe and with the brake-cylinder." None of these terms can be fairly applied to the Boyden device or to any of its details; and we think that the circuit court ruled correctly in holding that claim 4 is not infringed by Boyden.

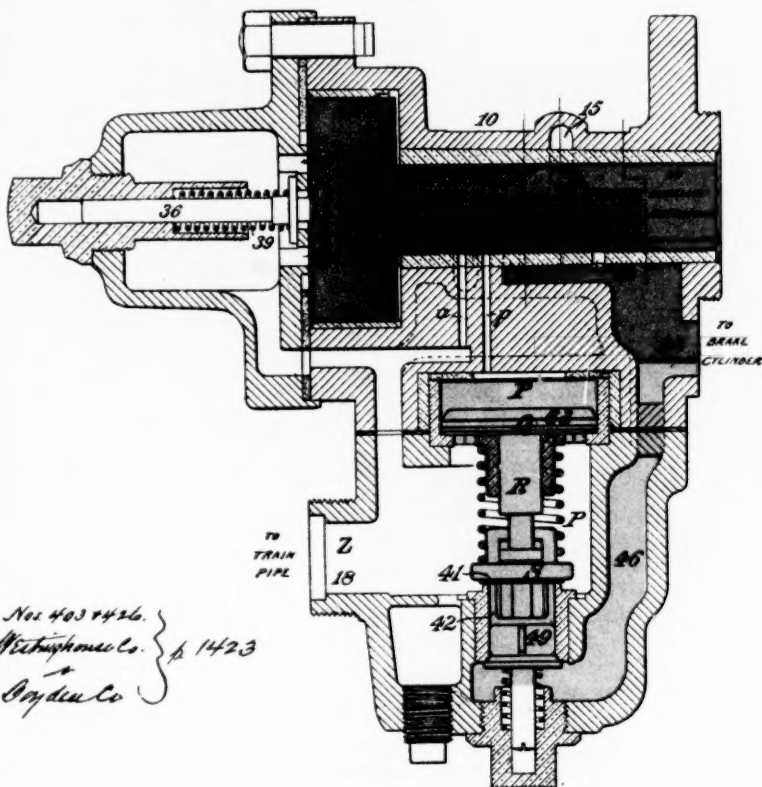
The distinction suggested by the circuit court between inventions employing cranks and levers visible to the senses, and those employing compressed air which operates by modes not visible to the senses,—as to which latter devices, the circuit court held that "in judging of an infringement we are to direct our attention rather to functional equivalents than to mechanical equivalents,"—we do not think well taken even in favor of pioneer inventions. The Supreme Court in its ruling in the great leading case of *O'Reilly v. Morse*, 15 Howard, 62, which was one in which the far more subtle agency of electricity was under consideration, neither made nor intimated such a distinction.

As to the adjudications in the Federal courts of the southern district of New York, on the subject of the air brakes invented by Westinghouse, it is incumbent upon us to consider whether the questions now before this court are in any respect *res judicata* and binding precedents in the case at bar. Technically they are not. The patent charged to have been infringed, in the first suit in the circuit court of New York, and on appeal in the appellate court of that circuit, was that taken out by Westinghouse, as number 376,837. That patent contained an important, indeed a vital, improvement upon number 360,070, which is in suit here, and which was found in practice to be insufficient for its purposes. It contained a supplemental or auxiliary piston, as well as an additional stem, an additional valve, and independent by-passes, composing an additional segregate machine, as we have before mentioned. In the second suit before the New York circuit and appellate courts, the parties complainant and defendant being the same and the defendant's invention being substantially the same, suit was based upon two patents of Westinghouse, numbers 360,070 and 376,837, and also upon a patent issued to H. S. Park, numbered 393,784. 1422 The question in both suits was, whether the air brake con-

BLEED. THROUGH POOR COPY

NEW YORK AIR BRAKE CO'S VALVE.

Decreed by Judge Lacombe to Infringe Patent No. 360,070, because it contains the "additional members" of that Patent.



The upper part of the mechanism in the above cut (colored blue) constitutes the "triple valve;" said parts are numbered 10, 11, 12, 14, 20, 36, 39 and 51.

The lower part (colored red,) infringes the Westinghouse invention because it includes the "additional members," a separate "auxiliary valve 41" and passage 46, leading from the train-pipe direct to the brake-cylinder.

It will be seen the above structure has the "two machines," the blue and the red the same as Patent 360,070, whereas Defendants' Structure Plate XI here in suit, has only one—the blue, and—therefore is minus the "additional members."

trived by the defendant in those suits had infringed the three patents. Judge Lacombe, who was affirmed on appeal, described the machine of the defendant there as having "the main air pipe (train-pipe), an auxiliary reservoir, a brake-cylinder, a triple valve"—the latter being the old triple-valve mechanism of patent 220,556, "and an auxiliary-valve device, independent of the main valve, for admitting air in the application of the brake directly from the main air pipe to the brake-cylinder." A diagram which illustrates this additional and "auxiliary-valve device, independent of the main valve" of the defendant in the New York suits, is given in the second brief or "oral argument" for appellants (Boyden) here, opposite page 36, and is attached to and made a part of this opinion.

(Here follows diagram marked p. 1423.)

It will be apparent, from an inspection of this diagram, that no decision affecting that device can effect one as different from it structurally and in every respect as is that of the Boyden device. It would require the verdict of a jury and the conclusive testimony of experts upon the question of mechanical equivalency to enable a court to decide whether they present a case of *res judicata*.

Prima facie, a decision founded upon one patent not in suit here, and another decision founded upon three patents collectively, one only of which is in suit here, the two decisions declaring that an invention used by a defendant who is not the defendant here, against the machine of that defendant differing widely in its structure from the one complained of here, cannot be treated as binding in the decision which this court may feel bound to render in the suit at bar.

Here it is contended that the mere use of the extreme traverse of the triple-valve piston to effect the same *functional* result, which was effected by Westinghouse in 360,070, constitutes an infringement, irrespectively of the additional means employed. There it was ruled that the use of the extreme traverse *and* of an additional machine attached to the original 220,556, which was structurally and *mechanically* equivalent to 360,070, was an infringement of the latter patent. The cases are different and not on all-fours with each other, and do not control or affect our own ruling.

Decrees will be entered, in accordance with the views expressed in this opinion, affirming the ruling of the court below in respect to claims *one* and *four* of the complainant's patent, number 360,077, and reversing the ruling of the court below in respect to claim *two* of the said patent.

1424 At the same term, to wit: November 11, 1895, the court here made and entered the following decree, to wit:

Decree.

United States Circuit Court of Appeals, Fourth Circuit.

BOYDEN POWER BRAKE COMPANY <i>et al.</i> , Appel-	}	Nos. 131 and 134.
lants,		
<i>vs.</i>		
WESTINGHOUSE AIR BRAKE COMPANY <i>et al.</i> ,		
Appellees,		
and		
WESTINGHOUSE AIR BRAKE COMPANY <i>et al.</i> ,	}	
Appellants,		
<i>vs.</i>		
BOYDEN POWER BRAKE COMPANY <i>et al.</i> , Appel-		
lees.		

Appeal and cross-appeal from the circuit court of the United States for the district of Maryland.

This cause came on to be heard on the transcript of the record from the circuit court of the United States for the district of Maryland, and was argued by counsel.

On consideration whereof, it is now here ordered, adjudged, and decreed by this court, that the decree of the said circuit court, in this cause, be, and the same is hereby, affirmed with respect to claims one and four of the complainant's patent number 360,-70, and reversed with respect to claim two of the said patent. And this cause is remanded to the circuit court of the United States for the district of Maryland with direction to enter a decree therein in conformity with the opinion and decree of this court. Costs in this court to be paid by Westinghouse Air Brake Company.

It is further ordered that the mandate of this court issue after the expiration of twenty days from the date hereof.

CHARLES H. SIMONTON,
Circuit Judge.

November 11th, 1895.

1425

Petition to Stay Mandate.

Filed November 25, 1895.

United States Circuit Court of Appeals, Fourth Circuit.

BOYDEN POWER-BRAKE COMPANY <i>et al.</i> ,	}	No. 131. Appeal from the Circuit Court of the United States for the District of Mary- land.
Appellants,		
<i>vs.</i>		
WESTINGHOUSE AIR-BRAKE COMPANY <i>et</i>	}	
<i>al.</i> , Appellees.		

WESTINGHOUSE AIR-BRAKE COMPANY <i>et</i>	}	No. 134. Cross-appeal from the Circuit Court of the United States for the District of Mary- land.
<i>al.</i> , Appellants,		
<i>vs.</i>		
BOYDEN POWER-BRAKE COMPANY <i>et al.</i> ,	}	
Appellees.		

Motion for stay of mandate.

And now, to wit, come The Westinghouse Air Brake Company and George Westinghouse, Jr., appellees in cause No. 131, and appellants in cause No. 134, by George H. Christy, their counsel, and move the court that the mandates in said causes be stayed for such time as to the court may seem meet, to the end that the said movers herein may, before the issue of such mandates, have time to prepare and present to the supreme court their petition for a writ of *certiorari* therein, with reasonable allowance of time for the action of said court thereon.

And said counsel hereby certifies to the court that no injunction was issued against defendants from the court below, so that the defendants are not now and have not been under injunction at any time herein—this fact having also been stated and admitted in open court at the hearing in this court.

GEORGE H. CHRISTY,
Att'y for Westinghouse Air Brake Co.
and George Westinghouse, Jr.

Pittsburg, Pa., Nov. 23, '95.

1426

Objections to Stay of Mandate.

Filed Dec. 5, 1895.

United States Circuit Court of Appeals, Fourth Circuit.

BOYDEN POWER-BRAKE COMPANY <i>et al.</i> ,	}	No. 131. Appeal from the Circuit Court of the United States for the District of Maryland.
Appellants,		
<i>vs.</i>		
WESTINGHOUSE AIR-BRAKE COMPANY	}	No. 134. Cross-appeal from the Circuit Court of the United States for the District of Mary- land.
<i>et al.</i> , Appellees.		
WESTINGHOUSE AIR-BRAKE COMPANY	}	
<i>et al.</i> , Appellants,		
<i>vs.</i>		
BOYDEN POWER-BRAKE COMPANY <i>et al.</i> ,	}	
Appellees.		

To the Hon. Nathan Goff, justice of the cir. ct. of appeals for the fourth circuit.

SIR: We desire to appear before your honor, by counsel, for the purpose of opposing the motion made by Westinghouse for a stay of mandate in the above-entitled cause.

We suggest that Wednesday, December 4th, 1895, would be a convenient day, this date giving both sides time for preparation, or any other date that may be convenient for your honor.

We respectfully request that your honor will indicate to us the time and place for the hearing.

A copy of this notice is this day mailed to Geo. H. Christy, Esq., attorney for Westinghouse Air Brake Co. and Geo. Westinghouse Jr., at Pittsburg, Pa.

Respectfully,

BOYDEN BRAKE CO.
G. H. BOYDEN, *Pres't.*

Baltimore, Md., November 26th, 1895.

1427

Order of Court Refusing Stay of Mandate.

Filed Dec. 5, 1895.

United States Circuit Court of Appeals, Fourth Circuit.

BOYDEN POWER-BRAKE COMPANY <i>et al.</i> ,	}	No. 131. Appeal from the Circuit Court of the United States for the District of Maryland.
Appellants,		
<i>vs.</i>		
WESTINGHOUSE AIR-BRAKE COMPANY	}	
<i>et al.</i> , Appellees.		
WESTINGHOUSE AIR-BRAKE COMPANY	}	No. 134. Cross-appeal from the Circuit Court of the United States for the District of Mary- land.
<i>et al.</i> , Appellants,		
<i>vs.</i>		
BOYDEN POWER-BRAKE COMPANY <i>et al.</i> ,	}	
Appellees.		

The motion made by The Westinghouse Air Brake Company and George Westinghouse, Jr., appellees in said cause No. 131, and appellants in cause No. 134, to stay the mandates therein for such time as will enable counsel to prepare and present to the Supreme Court a petition for a writ of *certiorari*, with reasonable allowance of time for the action of said court thereon, was this day heard, counsel for said parties, respectively appellants and appellees, being present, on consideration whereof, it is ordered that said stay be refused, and the clerk is directed to send down the mandates aforesaid as heretofore provided for.

NATHAN GOFF,
Circuit Judge.

Dec. 5th, 1895.

1428

Mandate.

Issued — filed Dec. 9, 1895.

UNITED STATES OF AMERICA, ss :

Seal of the Court. The President of United States of America to the honorable judges of the circuit court of the United States for the district of Maryland, Greeting :

Whereas, lately in the circuit court of the United States for the district of Maryland, before you, or some of you, in a cause between George Westinghouse, Jr. and Westinghouse Air Brake Co., complainants, Boyden Power Brake Company, *et al.*, defendants, wherein the decree of the said circuit court entered in the said cause on the 25th day of April, 1895, is in the following words, to wit :

And now, to wit, this 25th day of April, 1895, the above-entitled cause having come on regularly for hearing, before the Honorable

Thomas J. Morris, district judge, holding circuit court, on bill, answer, replication and proofs taken by and on behalf of the respective parties hereto, and having been argued by Mr. George H. Christy and Mr. Frederic H. Betts for complainants, and by Mr. Lysander Hill, Mr. Skipwith Wilmer and Mr. Hector T. Fenton for defendants, and the court having considered the same, and being duly advised in the premises, it is thereupon ordered, adjudged and decreed:

1st. That the letters patent recited in complainants' bill of complaint, to wit, letters patent of the United States, No. 360,070, dated March 29, 1887, and granted to George Westinghouse, Jr., for a new and useful improvement in fluid-pressure automatic brake mechanism, are a good and valid patent in all respects as regards and to the extent of the subject-matter of invention referred to and summed up in the several claims declared upon herein, to wit: claims numbered one, two and four of said recited patent; that George Westinghouse, Jr., was the true, original and first inventor thereof; and that the complainants have a good and sufficient title thereto, and are entitled to the exclusive right therein and thereunder.

2nd. That the defendants above named by the manufacture, use and sale of fluid-pressure automatic brake mechanism, as set forth and shown in and by the proofs herein, and (for greater certainty herein) more particularly as shown and described in certain

1429 letters patent of the United States, No. 481,134 and No. 481,135, both dated August 16, 1892, and both granted to The Boyden Brake Company, assignee of George A. Boyden, defendants herein, having infringed the said second claim of said recited patent No. 360,070, and have violated the exclusive right of the complainants therein and thereunder, and that a writ of injunction, conformable to the prayer of said bill, and in the usual form, be issued by the clerk, perpetually enjoining and restraining the said defendants, and each of them from any further manufacture, use or sale of the apparatus, mechanism and devices complained of herein and of any other apparatus, mechanism or devices substantially such in construction and operation as that which is referred to in and constitutes the subject-matter of said second claim, and from doing any act or thing in infringement of said second claim, or violation of the exclusive right so as aforesaid vested in said complainants therein and thereunder.

3rd. That reference be made herein to G. Morris Bond, Esq., as master, to take, state and make return of an account of the gains and profits made by said defendants, as also of the damages suffered by said complainants by or on account of said infringement, and that the parties appear before the master and produce books and papers and render accounts as he may, from time to time, direct.

4th. That as regards claims one and four of said patent No. 360,070, the court being of the opinion that defendants' device hereinbefore referred to does not infringe the same, injunction is refused and the bill of complainant is, in reference to such claims, hereby dismissed.

5th. And it is further ordered that all questions of the allowance

Costs are reserved until the final decree; as by the inspection of transcript of the record of the said circuit court, which was brought into the United States circuit court of appeals, for the fourth circuit by virtue of the appeal of the Boyden Power Brake Company, et al., and the cross-appeal of George Westinghouse, Jr., and the Westinghouse Air Brake Company agreeably to act of Congress in the case made and provided, fully and at large appears. And whereas, in the term of May, in the year of our Lord, one thousand eight hundred and ninety-five, the said cause came on to be heard before the said United States circuit court of appeals for the fourth circuit, on the said transcript of record, and was argued and counsel:

On consideration whereof, it is now here ordered, adjudged and decreed by this court, that the decree of the said circuit court, in this cause, be and the same is hereby affirmed with respect to claims one and four of the complainants' patent number 100,070, and reversed with respect to claim two of the said patent. And this cause is remanded to the circuit court of the United States for the district of Maryland with direction to enter a decree therein in conformity with the opinion and decree of this court. Costs in this court to be paid by the Westinghouse Air Brake Company. It is further ordered that the mandate of this court issue after the expiration of twenty days from the date hereof.

CHARLES H. SIMONTON,
Circuit Judge.

November 11th, 1895.

You, therefore, are hereby commanded that such further proceedings be had in said cause, in conformity with the opinion and decree of this court as according to right and justice, and the laws of the United States, ought to be had, the said appeal and cross-appeal notwithstanding.

Witness the Honorable Melville W. Fuller, Chief Justice of our Supreme Court, the ninth day of December, in the year of our — one thousand eight hundred and ninety-five.

HENRY T. MELONEY,
*Clerk of the U. S. Circuit Court of Appeals
for the Fourth Circuit.*

Costs of Boyden P. B. Co.

Clerk	\$52 45
One-half printing record	104 50
Attorney	20 00
	<hr/>
	\$176 95

February 17, 1896, writ of certiorari of the Supreme Court of the United States, dated January 30, 1896, was produced removing the aforesaid causes into the said Supreme Court.

1431 & 1431½ UNITED STATES OF AMERICA :

I, Henry T. Meloney, clerk of the United States circuit court of appeals for the fourth circuit, do certify that the foregoing is a true transcript of the entire record and proceedings of the said circuit court of appeals in the therein-entitled causes as the same remains upon the files and records of the said circuit court of appeals.

In testimony whereof I hereto set my hand and affix the seal of the said United States circuit court of appeals for the fourth circuit, at Richmond, this 19th day of February, A. D. 1896.

HENRY T. MELONEY,
*Clerk United States Circuit Court of Appeals
for the Fourth Circuit.*

1432 UNITED STATES OF AMERICA, 88 :

The President of the United States of America to the honorable the judges of the United States circuit court of appeals for the fourth circuit, Greeting :

[Seal Supreme Court of the United States.]

Being informed that there is now pending before you a suit in which Boyden Power Brake Company *et al.* are appellants and George Westinghouse, Jr., and The Westinghouse Air Brake Company are appellees and George Westinghouse, Jr., and The Westinghouse Air Brake Company are appellants and Boyden Power Brake Company *et al.* are appellees, which suit was removed into the said circuit court of appeals by virtue of an appeal and cross-appeal from the circuit court of the United States for the district of Maryland, and we, being willing for certain reasons that the said cause and the record and proceedings therein should be certified by the said circuit court of appeals and removed into the Supreme

1433 Court of the United States, do hereby command you that you send without delay to the said Supreme Court as aforesaid the record and proceedings in said cause, so that the said Supreme Court may act thereon as of right and according to law ought to be done.

Witness the Honorable Melville W. Fuller, Chief Justice of the United States, the 30th day of January, in the year of our Lord one thousand eight hundred and ninety-six.

JAMES H. MCKENNEY,
Clerk of the Supreme Court of the United States.

1434 [Endorsed:] Supreme Court of the United States. No. 847. October term, 1895. Boyden Power Brake Company *et al.* vs. George Westinghouse, Jr., *et al.* Writ of certiorari. The execution of the within writ appears from the certified transcript of the record in the causes therein mentioned, which said transcript is

hereto annexed. Henry T. Meloney, clerk U. S. circuit court of appeals, 4th circuit. February 19, 1896.

Endorsed on cover: Case No. 16,137. U. S. circuit court of appeals, fourth circuit. Term No., 403: Boyden Power Brake Company *et al.*, appellants, *vs.* George Westinghouse, Jr., and The Westinghouse Air Brake Company. Case No. 16,168. Term No., 426: George Westinghouse, Jr., *et al.*, appellants, *vs.* Boyden Power Brake Company *et al.* Writ of certiorari and return. Filed February 20, 1896.



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FILED 18000
JAN 13 1896
JAMES H. MCKENNEY,
CLERK

United States Supreme Court.

In the Matter of the Petition

OF

GEORGE WESTINGHOUSE, Jr., and THE WESTINGHOUSE
AIR BRAKE COMPANY for a Writ of Certiorari, etc.

PETITION.

GEORGE H. CHRISTY,

Solicitor for Petitioners,

FREDERIC H. BETTS,

J. SNOWDEN BELL,

BERNARD CARTER & SONS,

Of Counsel.

TO THE SUPREME COURT OF THE UNITED STATES OF AMERICA :

The petition of George Westinghouse, Jr., and The Westinghouse Air Brake Company, for a writ of *certiorari*, directed to the United States Circuit Court of Appeals for the Fourth Judicial Circuit, under the provisions of Section 6 of the Act of Congress, approved March 3d, 1891, and ordering that the Records in a certain appeal and cross-appeal be certified to this Honorable Court for its review and determination.

Said appeal is entitled as follows :

Boyden Power Brake Company, George A. Boyden, President; Charles B. Mann, Secretary; William Whitridge, Treasurer; and Boyden Brake Company, Defendants and Appellants, versus George Westinghouse, Jr., and The Westinghouse Air Brake Company, Complainants and Appellees, No. 131, in said Circuit Court of Appeals.

And the said cross-appeal is entitled as follows :

George Westinghouse, Jr., and The Westinghouse Air Brake Company, Complainants and Appellants, versus Boyden Power Brake Company, George A. Boyden, President; Charles B. Mann, Secretary; William Whitridge, Treasurer; and Boyden Brake Company, Defendants and Appellees, No. 134, in said Circuit Court of Appeals.

Statement of Case.

And your said petitioners thereupon respectfully show to this Honorable Court, as follows :

FIRST. Your petitioners are, and at the time hereinafter mentioned were, citizens of the State of Pennsylvania—the said The Westinghouse Air Brake Company being a corporation duly organized under the laws of said State.

SECOND. Your petitioners, complainants therein, brought suit by bill in equity in the U. S. Circuit Court for the District of Maryland,

for infringement of certain Letters Patent of the United States, against the Boyden Power Brake Company, George A. Boyden, President, Charles B. Mann, Secretary and William Whitridge, Treasurer, defendants therein. By subsequent proceedings, Boyden Brake Company became also a party defendant. All the said parties defendant were citizens of the State of Maryland, and the said Boyden Power Brake Company and Boyden Brake Company were, and so far as is known, still are, corporations organized under the laws of the said State of Maryland.

THIRD. The patent for infringement of which the said suit was brought and prosecuted is Letters Patent of the United States No. 360,070, granted to George Westinghouse, Jr., one of your petitioners, March 29th, 1887, for an Improvement in Fluid-Pressure Automatic Brake Mechanism, the title whereof was, at the time of bringing said suit, duly vested in your petitioners, complainants therein. And infringement was charged of claims 1, 2 and 4 of said patent.

FOURTH. In due time, the said cause came on for hearing on bill, answer, replication and proofs, and was argued before the Honorable THOMAS J. MORRIS, holding Circuit Court. An opinion therein was subsequently rendered by His Honor Judge MORRIS, and a decree was entered in conformity therewith—holding, *inter alia*, that the said Letters Patent No. 360,070 was a good and valid patent; that complainants had a good title thereto; that the defendants therein had not infringed claims 1 and 4 of said patent, but had infringed claim 2 of said patent. As to claims 1 and 4, the bill was dismissed, but as to claim 2 an injunction was allowed, with reference to a Master for an account.

The opinion of the Court therein is reported in 66 Fed Rep., 997, and a copy is annexed as an exhibit hereunto.

FIFTH. Thereupon each party appealed to the Circuit Court of Appeals for the Fourth Circuit.

The defendants therein, Boyden Power Brake Company *et al.* appealed under Section 7 of the Circuit Court of Appeals Act of March 3d, 1891, from so much of the said decree as granted or allowed an injunction under claim 2 of said Patent No. 360,070. Said appeal is the case first above recited, and was docketed in said Court of Appeals as No. 131.

The complainants therein, your petitioners herein, appealed from so much of said decree as *refused* an injunction under claims 1 and 4 of said Patent No. 360,070—and this, under the amendment to said act, approved February 18th, 1895, providing for such appeals—this last appeal being the cross-appeal above recited, and docketed in said Court of Appeals as No. 134.

SIXTH. The said appeals came on for hearing in the said Court of Appeals, before the Honorable Circuit Judges GOFF and SIMONSON and District Judge HUGHES, and were argued in said Court as one case.

Subsequently, and on or about the eleventh day of November, 1895, the opinion of the Court was rendered therein by his Honor Judge HUGHES, *inter alia*, affirming the decree of the Circuit Court under claims 1 and 4 of said patent, and reversing the decree of the said Court under claim 2 of said patent.

SEVENTH The said recited Patent No. 360,070 is confessedly the “ground floor” or “pioneer” patent for the modern “quick-action” railway train brake, as will appear by adjudications of the Courts therein.

An improvement thereon, also held by the Courts to be of high rank in the art, was shortly afterwards patented to George Westinghouse, Jr., one of your petitioners, by Letters Patent No. 376,837, dated January 24th, 1888, the title to which latter patent also became vested in your petitioners.

EIGHTH. In a suit brought by your petitioners against the New York Air Brake Company *et al.*, in the Second Circuit, for infringement, *inter alia*, of the Patent last above named, to wit, No. 376,837, the Court found it necessary to construe not only the said Patent No. 376,837, for infringement of which the suit was brought, but also the said earlier and pioneer Patent No. 360,070. This was done by His Honor Judge TOWNSEND, sitting as Circuit Judge at the final hearing of said cause, the same being known in the reports as No. 4977. Judge TOWNSEND's opinion is reported in 59 Fed. Rep. 581.

NINTH. Said cause No. 4977 having been taken by appeal to the U. S. Circuit Court of Appeals for the Second Circuit, was heard by the Honorable Circuit Judges WALLACE, LACOMBE and SHIPMAN, and

the unanimous opinion of the Court therein was rendered on or about October 15th, 1894, by His Honor Judge SHIPMAN.

In that Court, as in the Court below, it was found that the patent in suit, No. 376,837, was so intimately connected with the previous pioneer Patent No. 360,070 that to construe the former, it was necessary to first construe the latter.

The opinion of the Circuit Court of Appeals for the Second Circuit involving, *inter alia*, the proper construction of both these patents, is reported in 26 U. S. App. ; 11 C. C. A., 528; 63 Fed. Rep., 962. A copy thereof is hereunto annexed.

TENTH. Your petitioner The Westinghouse Air Brake Company, having in the meantime acquired the entire title to both said patents, brought another suit for a new infringement against the said The New York Air Brake Company *et al.* in the said Second Circuit. This new suit was based *inter alia*, as well on said Patent No. 360,070 as on said Patent 376,837. Motion was made for a preliminary injunction therein, which came on for hearing before his Honor Circuit Judge LACOMBE. After argument and consideration, the injunction was granted, as prayed for, under claims 1, 2 and 4 of said first or earlier Patent No. 360,070, as well as under claim 1 of said further Patent No. 376,837.

The opinion of his Honor Judge LACOMBE is reported in 65 Fed. Rep., 99, and being affirmed "*Per Curiam*" on appeal, as to Patent No. 360,070, a copy of Judge LACOMBE's opinion is hereunto annexed.

ELEVENTH. The defendants therein appealed to the Circuit Court of Appeals for the Second Circuit, and the appeal came on regularly for hearing before the Honorable Circuit Judges WALLACE and SHIPMAN and District Judge TOWNSEND. On or about May 28th, 1895, a "*Per Curiam*" decision was filed, *inter alia*, affirming the decision of Judge LACOMBE as to "the first, second and fourth claims of Patent No. 360,070." This decision is reported in 69 Fed. Rep., 715, and a copy thereof is hereunto annexed.

TWELFTH. That, as appears by the foregoing decisions and opinions, the Circuit Court of Appeals in the Second Circuit has adjudicated and declared, in one suit brought by your petitioners, that the second claim of your petitioner's Patent No. 360,070 is a valid claim, covering and protecting a legitimate and valuable sub-

ject matter, and the Circuit Court of Appeals for the Fourth Circuit, in another suit brought by your petitioners, has adjudged and declared that said second claim is invalid, and does not cover subject matter which can be lawfully claimed.

THIRTEENTH. That the subject matter of said second claim is of great value and importance to your petitioners, and is already involved in other suits and proceedings brought and pending in other causes unheard and undecided—and more particularly in a certain suit now pending in the U. S. Circuit Court for the Eastern District of Missouri, brought against the Lansburg Brake Company, *inter alia*, for the infringement of said claim 2 of said Patent No. 360,070.

FOURTEENTH. Your petitioners further show that said decisions or adjudications, in the Circuit Courts of Appeals for the Second and for the Fourth Judicial Circuit, are at variance or in conflict with each other, and that the errors of one or the other of them can only be authoritatively corrected in this Honorable Court.

Also that other of the matters of law so as aforesaid decided by the Circuit Court of Appeals for the Fourth Circuit are at variance with sundry of the decisions of this Honorable Court, as well as of other Circuit Courts of Appeal in other Circuits, and that any errors made therein can only be authoritatively corrected in this Honorable Court.

Your petitioners further allege that (as they are advised by their counsel and verily believe), as to all the matters so at variance, as well as to sundry and divers other matters, the said decision of the Circuit Court of Appeals of the Fourth Circuit contains manifest error of law, as well as of fact, material to the issues of the said cause.

FIFTEENTH. Your petitioners further represent that the matters as to which the Circuit Court of Appeals have adjudicated adversely to your petitioners, and more particularly the matters as to which said decision is in conflict with decisions made by other Circuit Courts of Appeal, and by this Court, are matters in which, if they are not corrected, the rights of your petitioners, as also the interests of the public, will suffer irreparable injury.

Your petitioners further represent that the irreparable injury to which they will be subjected by reason of an adverse, and, as your petitioners believe, erroneous decision by the Circuit Court of Appeals for the Fourth Circuit, is particularly apparent because the invention of the patent in suit, No. 360,070, is one which is used on upwards of 400,000 freight cars at the present time, and said freight cars are operated on all the railroads of the country, and may be found on every railroad from Maine to Florida, and from Boston to San Francisco. Such cars traverse every judicial district in the United States, and infringements upon the said Patent No. 360,070 are likely to occur, and have, in fact, occurred, as your petitioners believe, in every judicial district of the Circuit Courts of the United States, and it will be an irreparable and intolerable source of injury to your petitioners if their Patent No. 360,070, which, as they verily believe, covers and protects them in the exclusive enjoyment of an invention of the character described therein, which is universally used throughout the whole of the United States and in all judicial circuits thereof, should be rendered practically, or, at all events, to a very large extent, useless and inefficient for their protection; because whilst its validity has been sustained by the Circuit Court of Appeals for one Circuit, its validity has been denied by the Circuit Court of Appeals for another circuit.

Such a condition of conflicting decisions it is the proper province of this Honorable Court, as your petitioners are advised, to correct and obviate.

Assignments of Variance and Error.

FIRST. As to the validity of claim 2 of the patent in suit, No. 360,070, as matter of law on the face of such claim, the decision of the Court of Appeals for the Fourth Circuit is in terms, and apparently in scope and effect, irreconcilably at variance with the holding of the U. S. Circuit Court of Appeals for the Second Circuit.

And herein, your petitioners submit the following extract from the opinion of the Court of Appeals for the Fourth Circuit, in the cases Nos. 131 and 134, now sought to be brought before your Honorable Court by writ of *certiorari*:

" We think that when claim 2 of 360,070, in its language describing the action of that device, failed to describe any means by which the extreme traverse of the piston produced it, declaring merely that the piston ' by a further traverse, admits air directly

"from the main air pipe to the brake cylinder," it was fatally "defective, claiming only a result which is public property and not identifying the specific means (his own property) by which the result is achieved" (Opinion, p. 19).

In the Court of Appeals in the Second Circuit, this claim 2 of Patent 360,070 was held to be valid.

SECOND. As matter of error herein, your petitioners submit that the said decision of the said Circuit Court of Appeals for the Fourth Circuit, that said claim 2 of Patent No. 360,070 is "fatally defective" in matter of form, or in the substance thereof, is not well founded in fact or in law.

THIRD. As further matter of error herein, your petitioners respectfully submit that manifest error was made by the said Circuit Court of Appeals for the Fourth Circuit, in its rulings as to the effect of the proceedings in and action of the U. S. Patent Office, and herein (Opinion, p. 17).

(1) That error was made in holding as matter of law or fact, without proof, that the said Patent Office "employs the best experts in mechanics which it can secure in this and other countries."

(2) That error of fact was made in holding that the examinations made in the U. S. Patent Office, though "*ex parte* in form," are "nevertheless conducted under hot and skillful contestation in every case of importance."

(3) That, possibly by these errors of fact, error of law was made wherein it was held by the said Court that in granting a later patent to Boyden, without notice of any kind, "that action by the office was in effect a ruling that the Boyden device did not infringe Westinghouse Quick-Action Patent No. 360,070."

(4) Further error was made in holding as matter of evidence that "that ruling [of the Patent Office] takes rank here as the testimony of experts of the highest experience, skill and knowledge in mechanics."

FOURTH. And as matter of error and variance herein, your petitioners respectfully represent that the force and meaning of the phrase "substantially as set forth," as explained and applied by the said Circuit Court of Appeals for the Fourth Circuit, is directly at variance with the decisions of this Court, and is in error as matter of law (Opinion, pp. 15, 16).

FIFTH. As further matter of error herein, and as a matter irreconcilably at variance with the ruling of the Circuit Court of Appeals in the First Circuit, your petitioners further submit that manifest error was made by the said Circuit Court of Appeals for the Fourth Circuit in holding as matter of law that *the mere erasure* from the original specification of a description of a proposed modification operates as a *disclaimer* of such modification.

And your petitioners respectfully represent to your Honorable Court that in the said decision or opinion of the said Circuit Court of Appeals for the Fourth Circuit, there are sundry and divers other errors manifest on the record material to the issues therein, but which cannot be made readily intelligible except by a comparatively full reference to the testimony and exhibits therein, with possibly the aid of an oral argument. And herein your petitioners would submit anew the assignments of error entered in case No. 134 (Cross-Appeal Rec., pp. 3-5), in connection with the cross-appeal, as also the following :

SIXTH. The Court erred in holding that defendant's valve 22 is an integral valve, or that complainant's patent is limited to a non-integral valve.

SEVENTH. The Court erred in passing at all on the question of an integral as distinguished from a non-integral valve—this, under the pleadings and proofs herein, presenting purely a *moot* case or question.

EIGHTH. The Court erred in holding that defendant's apparatus was not an infringement of claims 1, 2 and 4 of complainant's patent, and each of them.

NINTH. The Court erred in holding that Patent No. 217,838 had ever been used, or was capable of any practically beneficial commercial use, either alone or in connection with Patent No. 220,556, all the proofs being the other way.

TENTH. The Court erred in holding that Patent No. 220,556 ever made, or was capable of making, what is known in this case as an emergency stop—all the proofs being the other way.

ELEVENTH. The Court erred in holding that in Patent No.

220,556, the ordinary work of braking was performed by a partial traverse of the triple piston—all the proofs being to the contrary.

TWELFTH. The Court erred in not reversing the decree of the Court below in case No. 131, and in not affirming the decree of the Court below in case No. 134.

Finally, your petitioners aver that the present case is one in which it is proper for this Court to issue a writ of *certiorari* for the following reasons :

1. The first assignment of error relates to and involves a conflict of decisions by courts of last resort on a matter of law in identically the same question ; that is to say :

Is claim 2 of the Westinghouse Patent "*fatally defective*," because it claims "*only a result*," as decided by the Circuit Court of Appeals for the *Fourth* Circuit, November 11th, 1895 ; or is it valid as held by the Circuit Court of Appeals for the *Second* Circuit, on May 28th, 1895 ?

2. Under the second assignment of error, traverse is made of the correctness of the decision in the *Fourth* Circuit, as affected by the form or phraseology of the claim.

3. The rulings made in the *Fourth* Circuit, as to practice and procedure in the Patent Office, are not only productive of irreparable injury to your petitioners, but unless reviewed and corrected, will operate to the irreparable injury of all inventors and patentees, and especially of those who are entitled to be called pioneers in the arts. If the grant of a *later* patent be a ruling by the Patent Office of non-infringement, and if such ruling be allowed to "take rank as "testimony in the case, of experts of the highest experience, skill "and knowledge in mechanics," the rights of the earlier pioneer patentees cannot be otherwise than irreparably injured thereby—and this under the third assignment of error.

4. Under the fourth assignment of error, it is submitted that the Court of Appeals in the *Fourth* Circuit have adopted a meaning or construction for the words "substantially as described," which is directly at variance with that established by the Supreme Court.

Also, that when dealing with a pioneer patent, Judge HUGHES "confines the inventor's rights to his own means," etc., he is directly and again at variance with the repeated rulings of the Supreme Court, both generally, and also specially in that no distinction is thus drawn between those "means" which are material and substantial, in the combination claimed as such, and such other "means" as are *neither* material nor substantial, to the combination claimed, as such.

5. And under the fifth assignment of error, the decisions in the First and Fourth Circuits are irreconcilably at variance.

And this also involves a question of practice which can only be settled by the Supreme Court, and which, being an important one, not only to your petitioners, but to inventors and patentees generally, ought to be so settled.

Other assignments of error, though material and believed to be well founded, can best be made intelligible by the use of the exhibits and by oral argument.

A certified copy of the entire record of the said recited cases in the Circuit Court of Appeals for the Fourth Circuit, is filed herewith as part of this application.

Whereupon your petitioners respectfully pray that this Honorable Court will be pleased to grant a writ of *certiorari*, requiring the first above-entitled cases, Nos. 131 and 134, in the U. S. Circuit Court of Appeals for the Fourth Judicial Circuit, to be certified to this Honorable Court for its review and determination.

GEORGE WESTINGHOUSE, JR.

THE WESTINGHOUSE AIR BRAKE CO.

By GEORGE WESTINGHOUSE, JR., Pres.

FREDERIC H. BETTS,

GEORGE H. CHRISTY,

Of Counsel for Petitioners.

In the Circuit Court of the United States.

FOR THE DISTRICT OF MARYLAND.

GEORGE WESTINGHOUSE, JR., and THE
WESTINGHOUSE AIR BRAKE COMPANY

VS.

THE BOYDEN POWER BRAKE COMPANY.

In Equity.

(Decided March 11, 1895.)

J. Snowden Bell, Bernard Carter, George H. Christy
and *Frederic H. Betts*, for complainants.

Barton & Wilmer, Cowen & Cross, Hector T. Fenton
and *Lysander Hill*, for defendant.

This is a bill in equity, in usual form, charging the defendant with infringing the Westinghouse Patent No. 360,070, dated March 29, 1887, for a fluid-pressure automatic brake mechanism.

The claims alleged to have been infringed by the defendant are claims 1, 2 and 4, which are as follows:

"1. In a brake mechanism, the combination of a main air-pipe, an auxiliary-reservoir, a brake-cylinder, a triple-valve and an auxiliary valve device, actuated by the piston of the triple-valve and independent of the main valve thereof, for admitting air in the application of the brake directly from the main air-pipe to the brake-cylinder, substantially as set forth.

"2. In a brake mechanism, the combination of a main air-pipe, an auxiliary-reservoir, a brake-cylinder and a triple-valve having a piston whose preliminary traverse admits air from the auxiliary-reservoir to the brake-cylinder, and which by a further traverse admits air directly from the main air-pipe to the brake-cylinder, substantially as set forth.

"4. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston-stem and governing ports and passages in the case leading to connections with an auxiliary-reservoir and a brake-cylinder and to the atmosphere, respectively, and an auxiliary valve actuated by the piston-stem and controlling communication between passages leading to connections with a main air-pipe and with the brake-cylinder, respectively, substantially as set forth."

The only defense now urged by the defendant is non-infringement.

The history of the pioneer invention of George Westinghouse, Jr., in fluid-pressure brakes, by means of which the brakes of a train of railroad cars can be operated by air pressure controlled by the engineer of the train, and the history of the successive steps and inventions by which he has devised mechanisms adapted to apply that power so as to act automatically on each car, and the scope and fundamental importance of his later inventions by which he has accelerated, in an astonishing degree, the quickness with which the brakes can be applied, almost simultaneously, on each car of a long train consisting of as many as fifty freight cars, has been carefully and fully stated by Judge TOWNSEND, who delivered the opinion in the case of *Westinghouse vs. New York Air Brake Co.* (59 Fed. Rep., 581), and by Judge SHIPMAN in the same case on appeal (63 Fed. Rep., 962), and in the opinion of Judge LACOMBE, filed December 27, 1894, in a case between the same parties in the United States Circuit Court for the Southern District of New York.

The patent now in suit, No. 360,070, March 29, 1887, is the first of the Westinghouse patents in which he describes an additional function, engrafted upon his automatic air-brake, which is intended to be used only in cases of unusual emergency, and which is intended to meet the difficulties of applying air-brakes quickly on long trains. The purpose of the device was to increase the quickness of the serial action

of the automatic brake mechanism on each successive car, by making the triple-valve device of each brake mechanism set in operation the valves on the car immediately in its rear, and at the same time to make use of the train-pipe air, vented for this purpose from the train-pipe at each triple-valve, so as to add its power to the power applied from the auxiliary-reservoir of each car.

The result which Westinghouse was seeking in the new device, described in Patent No. 360,070, was first, and principally, to vent the train-pipe at each car, so as to quicken the serial action of the brakes from car to car; and, secondarily, to utilize the vented air and not waste its power.

Westinghouse discovered that he could accomplish this result by so constructing the ordinary triple-valve of his automatic mechanism that, when in an emergency, the engineer, by widely opening his engineer's valve, and thereby causing a sudden and unusual release of pressure in the train-pipe, could cause the piston of the triple-valve to make an unusual and further traverse and thereby actuate a valve, which opened a port by which the train-pipe air was admitted suddenly and directly into the brake-cylinder, without passing through the auxiliary-reservoir.

This sudden release of air from the train-pipe vented that pipe at the first car, and that venting, in like manner, released the pressure in the train-pipe at the valve of the next car, and so on from car to car with almost instantaneous rapidity.

It is shown that this device, as first constructed, was not entirely successful. It applied the brakes with greatly increased serial rapidity, as compared with any former device, and with much greater power, but not so quickly but that the rear cars impinged against the forward ones with destructive shocks.

The reason for this appears to have been that the operation of venting was not carried far enough, because the port opened by the auxiliary valve was not of sufficient size and did not release the full volume of train-pipe air sud-

denly enough to vent it sufficiently. This defect was remedied by an improved mechanism, devised by Westinghouse and described in his Patent No. 376,837, January 24, 1888.

The success of this improved device has demonstrated that the invention, by which the further traverse of the triple-valve piston, beyond the extent of the traverse required for the ordinary application of the brakes, is made to admit a large volume of train-pipe air directly to the brake-cylinder, was one of great importance.

The proofs show that a quick-action automatic brake, which would give the results which this brake has accomplished, was eagerly sought after by inventors and car builders, and all had failed, until Westinghouse discovered that it could be done by this mode of operation.

In the cases above referred to, in which this Patent, No. 360,070, and the improvement on it, No. 376,837, were discussed with reference to the state of the art and the scope of the invention therein disclosed, these were held to be patents of a fundamental pioneer class, describing an invention of primary importance.

In those cases, the defendants, who were charged with infringing, were using a separate and independent valve to open the port to the train-pipe, and the question was whether or not Westinghouse was restricted to the form of independent valve and the precise mode of actuating it set out in his patent. It was held that he was entitled to a liberal construction of his claims, and that, in respect to the emergency valve, the form of his device was not of the essence of his invention.

In the Boyden mechanism, which is alleged in this case to infringe, I have not been able to satisfy myself that Boyden makes use of an auxiliary valve, in the sense in which that term is employed in the specification and in some of the claims of the Patent No. 360,070, now in suit.

It appears from the specification of Patent No. 360,070, that what Westinghouse meant by the auxiliary valve, which

is made one of the elements of the combination in the first and fourth claims, is such a valve as he has described in his specification, and which is independent of and performs none of the functions of the main valve of the ordinary triple-valve device, and I am not satisfied, notwithstanding the very positive testimony of the complainants' experts, that the poppet-valve 22 of the Boyden mechanism is such a valve; for Boyden's poppet-valve 22 does, as I understand its operation, to some extent, perform the functions of a main valve of the triple-valve, as well as the function of Westinghouse's auxiliary quick-action or emergency valve.

It is probably true that, in the Boyden mechanism, the stem valve *i, k, j*, which I take to be the equivalent of the sensitive graduating valve shown in the Westinghouse Patent No. 220,556, October 14, 1879, is so constructed that it may do, and probably in most cases does do, the work of ordinary braking; that is to say, that, by two or three successive applications of pressure through that smaller and more sensitive valve, the brake-cylinder is filled and the main valve 22 becomes non-essential, or, if lifted off its seat, is moved very gently; but valve 22 will, if the engineer uses his brake valve carefully, do the work of a main valve, as is demonstrated, I think, by the experiments in which the sensitive graduating valve *i, k, j*, was plugged up. So I take it that defendant's valve *i, k, j*, must be held to be the sensitive graduating valve usual in triple-valve devices since the Westinghouse Patent No. 220,556; and the defendant's valve 22 must be considered to be the main valve, and that in defendant's mechanism he has been able, by an ingenious arrangement, restricting the admission of auxiliary-reservoir air to the triple-valve chamber, to cause the main valve to do both main-valve work, when needed, and to do quick-action work, when needed.

As, by the explicit terms of claims 1 and 4, Westinghouse has restricted himself, as to those claims, to an auxiliary valve,

independent of the triple-valve, I hold that the defendant does not infringe those claims.

CLAIM 2.

Claim 2 reads as follows :

"2. In a brake mechanism, the combination of a main air-pipe, an auxiliary-reservoir, a brake-cylinder, and a triple-valve having a piston, whose preliminary traverse admits air, from the auxiliary-reservoir to the brake-cylinder, and which by a further traverse, admits air directly from the main air-pipe to the brake-cylinder, substantially as set forth."

The first three elements of this claim are the usual mechanism of an automatic air-brake; the remaining element, which was the only novel one at the date of the patent, is a triple-valve having a piston which, by two distinct movements, performs two distinct functions, the first, its preliminary traverse by which it admits air from the auxiliary-reservoir to the brake-cylinder, which is the ordinary effect of the usual movement of the triple-valve piston, and the second, its further traverse, which is a new and distinct use, admitting air directly from the main air-pipe to the brake-cylinder, resulting in venting the main air-pipe and in producing the quick-action.

Now this, as I understand it, was the invention which Westinghouse brought to light. He discovered, and by experiment demonstrated, that, by a further traverse of the triple piston, train-pipe air could be vented from the train-pipe and that it would give two very important results, namely; first, quickening of the action of the brakes from the forward to the rear cars so that the application of the brakes became almost instantaneous on all the cars, and, second, utilizing the vented air for direct action in the brake-cylinder. Now, although quick-action emergency brakes were being sought for, no one before Westinghouse had accomplished this result and the means by which he accomplished it were entirely novel. Indeed, upon

first impression, it is paradoxical and startling to find that, when a sudden, quick and powerful application of brakes is needed, in the face of impending danger, it is to be obtained by a sudden large release of the pressure in the train-pipe, to the extent of fifteen or twenty pounds below that in the auxiliary-reservoir, and that, by using this low-pressure air to operate the brake-cylinder, instead of the air under greater pressure stored in the auxiliary-reservoir, this remarkably effective application of the brakes is obtained. In the domain of quick-action brakes, this device would seem to belong to that class of pioneer inventions, the patents for which are to be construed so as to be co-extensive with the real invention, if the language of the claim will permit it.

It is shown that Westinghouse was the first who used a further traverse of the triple-valve piston to perform the operation required to vent the train-pipe into the brake-cylinder to effect quick-action. The result was new and the means were new. His claim 2 is broad enough in language to cover every device in which that is done by the further traverse admitting air directly from the train-pipe to the brake-cylinder, substantially by the means described in the specification; that is, by the further traverse actuating a valve which so admits the train-pipe air.

The result accomplished by defendant's mechanism is identical with that of Westinghouse, and the means, by which the mechanism is actuated, so alike, that, in its published trade catalogue, defendant claims that cars fitted with its valves can be used on the same trains with the Westinghouse quick-action brake, because the engineer, in applying or releasing the air-pressure, may treat them as identical; the same functional operations of the valves, and the same results, being obtained from the same changes in the engineer's brake valve, so that there is strong *prima facie* reason to suppose that Boyden's way of using the same release of pressure to vent the train-pipe and to actuate the valves, which produces identical results, may be Westinghouse's way.

In mechanisms actuated by air under pressure, the trans-

mission of power is not visible to the senses as plainly as when it is done by cranks and levers, and, being transmitted by an invisible agency in all directions in which the air can escape, the functions of the instrumentalities by which it operates are more important than their forms, and, in judging of an infringement, we are to direct our minds rather to functional equivalents than mechanical equivalents.

The use by Boyden of a central opening through the triple-valve piston, to admit train-pipe air to the triple-valve chamber, was not new, nor the use of a poppet-valve for the main valve of the triple, both of these constructions having been shown in the Westinghouse Patent No. 141,685, August 12, 1873, and in others of his patents. So that there is nothing in the Boyden device not before exhibited in some one of the Westinghouse Patents; except that he has been able to cause one of the valves of the triple (valve 22), at one stage of the application of brakes, to perform ordinary service work, and, at another, to do quick-action work. This Boyden does by an ingenious construction not before used, by which he restricts the passage of auxiliary-reservoir air into the triple-valve chamber, so that, when the further traverse of the piston suddenly unseats the poppet-valve 22, the port opened by it to the brake-cylinder is so large and the supply of auxiliary reservoir air through the restricted passage so feeble, that the train-pipe air raises its check-valve and vents itself into that chamber, and thence through the large port to the brake-cylinder. For the mechanism embodying this ingenious contrivance, by which the poppet-valve 22 is made capable of doing ordinary service work by a careful, intermittent, slow release of pressure by the engineer, and quick-action work by a quick, sudden release, patents were granted to Boyden (No. 481,135, August 16, 1892, and No. 481,136, August 16, 1892); but, if this construction contains the underlying invention of the patent in suit, which was granted March 29, 1887, Boyden cannot make use of his improvement during the life of that patent.

It is true that, in searching for some device which would give quick-action, Westinghouse had, before the date of the patent in suit, conceived the idea that it might be accomplished by venting the train-pipe at intervals along the train. He had tried having two or three vents, at intervals in the length of the train, controlled by electrical apparatus, and also had tried relief-valves placed in the pipe-coupling of each car, which would open to the atmosphere and vent the train-pipe quickly, in case of accident or other sudden release of pressure in the forward part of the train. This was shown in the Westinghouse Patent No. 217,838, July 22, 1879, but neither of these attempts were successfully applied, and they did not solve the problem of quick-action.

The problem was not solved; indeed, the first step in the direction of solving it does not appear to have been taken until the experiments which led to the Westinghouse Patent now in suit. The substance of the method then devised is the use of the sudden further traverse of the triple-valve piston to open a valve in a manner different from the valve opening made by the preliminary traverse for service braking, thereby admitting train-pipe air to the brake-cylinder without its passing through the auxiliary reservoir.

In the Westinghouse apparatus, the further traverse of the triple-valve piston causes it to impinge against an additional, separate valve which admits the train-pipe air. In Boyden's apparatus, used by defendant, the further traverse pulls the poppet-valve 22, which Boyden substituted for the ordinary main valve of the triple, suddenly off its seat, thereby, in the manner before mentioned, causing the train-pipe air to raise the check-valve and flow with volume, through the triple-valve chamber, direct to the brake-cylinder. The device in Boyden's apparatus, by which the difference of pressures in the triple-valve chamber, between auxiliary-reservoir air and the train-pipe air, is produced and used, is ingenious and admirable; but the result obtained is just the same as when, in the

Westinghouse apparatus, the auxiliary valve is unseated, and the means used are, in my judgment, functionally equivalent.

Under the ruling of *Morley Machine Co. vs. Lancaster*, 129 U. S., 263, and of the many cases cited in the opinion delivered in that case, the rights of a pioneer inventor are infringed by one who accomplishes the same result by means which, although never used for that purpose before, are mechanical equivalents for the means used by the inventor, under a liberal construction of his patent. It was said in that case by Mr. Justice BLATCHFORD (p. 273):

"Where an invention is one of a primary character and the mechanical functions performed by the machine are, as a whole, entirely new, all subsequent machines which employ substantially the same means to accomplish the same result are infringements, although the subsequent machine may contain improvements in the separate mechanisms which go to make up the machine."

In *McCormick vs. Talcot*, 20 How., 402, the controversy arose over a device which McCormick had added to his reaper called a divider, intended to separate the standing grain to be left from that which is to be cut. The Court said:

"If he be the original inventor of the device or machine called the divider, he will have the right to treat as infringers all who make dividers operating on the same principle and performing the same functions by analogous means or equivalent combinations, even though the infringing machine be an improvement of the original and patentable as such."

In *Machine Co. vs. Murphy*, 97 U. S., 120-125, it was said:

"Nor is it safe to give much heed to the fact that the corresponding device in two machines, organized to accomplish the same result, is different in shape or form the one from the other, as it is necessary in every such investigation to look at the mode of operation or the way the device works, and at the result, as well as at the means, by which the result is attained."

The language of the Supreme Court in Consolidated Valve Co. vs. Crosby Valve Co., 113 U. S., 157-171, is applicable.

"The prior structures never effected the kind of result attained by Richardson's apparatus because they lacked the thing which gave success. * * * Taught by Richardson, and by the use of his apparatus, it is not difficult for skilled mechanics to take prior structures and so arrange and use them as to produce more or less of the beneficial results first made known by Richardson."

It is true that a patentee can claim nothing beyond the scope of his patent (Keystone Bridge Co. vs. Phoenix Iron Co., 95 U. S., 274), but the scope and meaning of a broad claim in the patent can only be interpreted by an understanding of the real scope of the invention itself.

If the Westinghouse Patent now in suit is for an invention of a primary character, and if the gist of that invention is the use of the further traverse of the triple-valve piston to open a valve which admits air directly from the train-pipe to the brake-cylinder, with the result that the train-pipe is vented and the train-pipe air utilized, then it appears to me that the defendant cannot exculpate itself from the charge of infringement by the fact that, in its device, the train-pipe air is admitted through the triple-valve chamber and not through a by-passage, nor by the fact that in its device the further traverse of the piston opens the main valve in a special manner, which produces the same result, but does not make use of a separate auxiliary valve; provided, Westinghouse has not by the explicit terms of his claim 2 restricted himself to the use of an auxiliary valve.

I do not think Westinghouse has so restricted himself in claim 2, although he does appear to have done so in claims 1 and 4.

There is, without question, some difficulty and embarrassment in the broad construction of claim 2, growing out of the proceedings in the Patent Office, as shown by the

file wrapper and contents ; but, considering what was the real invention, I am not of the opinion that the legal effect of those proceedings is to restrict claim 2 to a device containing a separate auxiliary valve.

From the contents of the file wrapper, it appears that, as the application was prepared, the first claim of Patent No. 360,070 differed from that which now appears in the patent as granted.

The claim 1 first proposed was

"1. In a brake mechanism, the combination of a main air-pipe, an auxiliary-reservoir, a brake-cylinder, a triple-valve provided with a device for admitting air directly from the main air-pipe to the brake-cylinder, substantially as set forth."

It was objected by the Patent Office Examiner that this claim and also claim 2 were anticipated by Patent No. 280,285, to G. A. Boyden, June 26, 1883, and the Examiner requested that a working model of the triple-valve should be furnished.

Boyden's Patent of 1883, No. 280,285, was a form of triple-valve mechanism, intended for use with Westinghouse's automatic air-brake, the object of which was to provide for replenishing the auxiliary-reservoir of each car when the pressure therein had been lessened by leakage and while the brakes remained applied. This was done by the engineer causing, not a release, but a slight increase of the pressure in the train-pipe air, which, acting upon a check-valve in the centre of the triple-valve piston, by a peculiar arrangement of the valves, caused train-pipe air to pass together with auxiliary-reservoir air to the brake-cylinder. The object, function and result of whatever was new and patentable in this Boyden device was altogether different from the object, function and result of the Westinghouse device in Patent No. 360,070, and there seems to be no analogy or comparison which can be made between them.

It is true that the "always-open one-way passage" in the Boyden Patent which, when the check-valve was raised,

allowed train-pipe air to reach the brake-cylinder, was, in the language of the cancelled claim 1 of No. 360,070, "a device for admitting air directly from the main air-pipe to the brake-cylinder," and there were other devices, used by Westinghouse himself, which this wording would include; and the claim was, therefore, justly open to the criticism of the Patent Examiner; but there was no similarity in the means by which the two devices were actuated, no similarity in the object to be accomplished, and no similarity in the mechanical principle of operation. It was simply a fact that there did exist in the Boyden device a passage for train-pipe air direct to the brake-cylinder, which the engineer could cause to open by a slight increase of train-pipe pressure; but there was no hint or suggestion of the important discovery how that fact could be utilized to accomplish the entirely new function necessary to create a quick-action brake, when, in an emergency, quick-action was needed; and how, when quick-action was not needed, it should not interfere with ordinary graduation and service stops. This Boyden device was not in the direction of quick-action, but its opposite.

While, therefore, it was proper that Westinghouse's original claim 1 should be corrected, so as to express more definitely his real invention, this was not because the Boyden Patent, in any manner whatever, anticipated that invention, or suggested it in any of its functions.

For the same reason, there was then inserted in the specification of the Westinghouse Patent No. 360,070, this clause:

"I am aware that a construction, in which 'an always-open one-way passage' from the main air-pipe to the brake-cylinder is uncovered by the piston of the triple-valve, simultaneously with the opening of the passage from the auxiliary-reservoir to the brake-cylinder, has been heretofore proposed, and such construction, which involves an operation different from that of my invention, I, therefore, hereby disclaim."

In the Boyden infringing device now used by the defendant, the passage from the main air-pipe to the brake-cylinder is not "uncovered by the piston of the triple-valve, simultaneously with the opening of the passage from the auxiliary-reservoir to the brake-cylinder"; if it was, the defendant's mechanism would be always a quick-action brake and never anything else; but, on the contrary, in the infringing device, the passage is not opened until there has been a sudden further traverse of the piston, which then brings it into operation for the distinct purpose of quick action. The statement of the so-called disclaimer is strictly true, that the construction of the Boyden 1883 Patent "involves an operation different from" the Westinghouse invention, and the so-called disclaimer in reality disclaims nothing which has relation to the Westinghouse quick-action invention.

The disclaimer was substituted in the place of the following, which had been in the specification, and was cancelled :

"Further, while in the specific construction described and shown, the function of admitting air from the main pipe is performed by a valve separate from that which effects the preliminary admission of reservoir-pressure to the cylinder, a modification, in which the same office is performed by a valve integral with the main valve and formed by an extension thereof, would be included in and embody the essential operative features of my invention."

The testimony tends to prove that this clause of the specification was taken out because the Examiner objected that no such form of triple-valve was illustrated in the drawings. For whatever reason it may have been cancelled, it is not a necessary result that the patentee is precluded from claiming that his patent covers other forms of valve, integral with the main valve, if such is his legal right, when his invention, as disclosed in his patent, is found to be a broad one, and if he is not restricted by his claims and if he has done nothing to impair his right to be protected in his whole inven-

tion. The effort should be to preserve, rather than to forfeit, the inventor's rights.

Keystone Manufacturing Co. vs. Adams, 151
U. S., 144.

The object and scope of the invention, and the means employed to effect his object, are thus stated by Westinghouse in the specification of his patent in suit:

"The object of my invention, is to enable the application of brake-shoes to car wheels by fluid pressure to be effected with greater rapidity and effectiveness than heretofore, more particularly in trains of considerable length, as well as to economize compressed air in the operation of braking by utilizing in the brake-cylinders the greater portion of the volume of air which in former practice was directly discharged into the atmosphere. To this end, my invention, generally stated, consists in a novel combination of a brake-pipe, an auxiliary-reservoir, a brake-cylinder and a triple-valve device governing, primarily, communication between the auxiliary-reservoir and the brake-cylinder, and, secondarily, communication directly from the brake-pipe to the brake-cylinder."

This language exactly describes the infringing mechanism of the defendant.

The amendments made to meet the objections of the patent examiner are not to be construed to disclaim the patentee's actual invention, if such construction can be avoided without doing violence to the obvious meaning of the language.

Lake Shore Railway Co. vs. Car Brake Co., 110
U. S., 229-236.

Reese Button Hole Machine Co. vs. Globe Button Hole Co., 61 Fed. Rep., 958.

It has been urged that the invention disclosed by the patent in suit is not of a meritorious character, because, in the form in which it is there embodied, or at least in the first mechanism manufactured by Westinghouse, it failed of success in some essentials, and was immediately improved by Westinghouse, in a manner which was the subject of a subsequent patent, before it was successful in the use for which

it was intended. The defect developed by experimental test, and which Westinghouse in a few months remedied, was that the opening uncovered by the auxiliary valve was not sufficiently large to suddenly release the full volume of train-pipe air. This was not a defect inherent in the device (59 Fed. Rep., 581-591).

There were structural objections to making that opening large; but, when made larger, the device answered the purpose for which it was intended. It was thought, however, better to remedy the difficulty by adding an auxiliary piston, as well as an auxiliary valve, and it was in that line that Westinghouse carried his further improvements, and he has adopted that form, as the best to be manufactured for general use.

This defect in the patent in suit was not radical, and was only one of those defects common in the first forms of many pioneer inventions, which usually have to be improved upon before they attain commercial success.

It is further urged that in a doubtful case the scale should be turned by the fact that, subsequent to the date of the patent in suit, indeed more than two years after the institution of this suit, Patents Nos. 481,135 and 481,136, August 16, 1892, were granted to Boyden for the mechanism now used by the defendant.

Boyden was entitled to patents for whatever was a patentable novelty in the devices by which he was able to make his valve 22 answer for both service and quick-action work, in connection with the restricted passage B, and for any other patentable novelty in the forms of his mechanism. The widely different forms in which he has illustrated his devices in the two above-mentioned patents show that, taking what Westinghouse had discovered and demonstrated to be the underlying principle of a quick-action brake, a skillful and inventive mechanic can devise many forms for applying it.

But, in his specification of Patent No. 481,135, Boyden alleges that his device differs essentially from Westinghouse's Patent No. 360,070, and involves a new mode of

operation. The question whether it does or not, was the very question pending in this suit, and, so far as the Examiner passed upon it, in allowing the specification to stand, he did so upon the *ex parte* application of Boyden and unassisted by testimony as to the state of the art at the date of the Westinghouse Patent, without testimony as to the scope of the Westinghouse quick-action invention and its great importance and merit; and, therefore, without the opportunity of judging whether or not it was a pioneer invention of a fundamental character, entitled to a construction co-extensive with the invention, or was simply a patent for an improvement in a known art, to be restricted to the form of the device shown in the model and illustrations.

The determination of that question is the starting point in the consideration of the controversy and, in my judgment, the fact that Westinghouse was the first discoverer of the vital underlying invention, should turn the scale in his favor.

The complainants are entitled to a decree for an injunction and account, with a reference to a Master in the usual form.

United States Circuit Court of Appeals

FOR THE SECOND CIRCUIT.

THE WESTINGHOUSE AIR BRAKE
COMPANY

vs.

THE NEW YORK AIR BRAKE COMPANY
ET AL.

Nos. 4976 and
5315.

GEORGE WESTINGHOUSE, JR., and THE
WESTINGHOUSE AIR BRAKE COMPANY

vs.

THE NEW YORK AIR BRAKE COMPANY
ET AL.

No. 4977.

SHIPMAN, C. J. :

The various appeals in these three cases are from decrees of the Circuit Court for the Southern District of New York, upon three bills in equity for the alleged infringement of Letters Patent. No. 4977 was founded upon Letters Patent No. 376,837, dated January 24, 1888, and Letters Patent No. 172,064, dated February 11, 1876, each issued to George Westinghouse, Jr. The Circuit Court decreed that the defendants should

be enjoined against their infringement of the first, second and third claims of No. 376,837, and that the bill should be dismissed as to No. 172,064. No. 5315 was founded upon Letters Patent No. 448,827 to George Westinghouse, Jr., dated March 24, 1891. The Circuit Court decreed that the defendants should be enjoined against the infringement of the first and second claims of this patent.

No. 4976 was founded upon Letters Patent No. 393,784, dated December 4, 1888, to Harvey S. Park, and No. 222,803, dated December 23d, 1879, to George Westinghouse, Jr. The Circuit Court dismissed the bill as to No. 393,784, and decreed that an injunction should issue against the infringement by the defendants of the second, third and fourth claims of No. 222,803. The complainants and defendants have respectively appealed from the decrees which were respectively adverse to them.

These patents are for improvements in railroad brakes by fluid pressure, and will be better understood if they are considered in the order of their relation to each other, rather than as they are grouped in the bills in equity, and therefore Nos. 376,837 and 448,827, which was originally applied for in the application which resulted in No. 376,837, naturally take precedence.

It is necessary to give the history of the development by the patentee of the automatic "quick-action" air-brake system, because the construction of the important claims of the two patents now under consideration and of the patent to Park, No. 393,784, depends to a great degree upon a knowledge of this history, which was accurately condensed by Judge TOWNSEND, as follows :

"The first practical air brake is known as the 'plain brake,' and is described in Patent No. 88,929, granted to George Westinghouse, Jr., April 13, 1869.

"It consisted of a pump, operated by steam from the locomotive boiler, which compressed air into a reservoir located under the locomotive cab, which reservoir

communicated by a pipe with a cock or valve in said cab called the 'engineer's valve,' which was so located as to be readily manipulated by the engineer.

"From this valve a pipe extended back under the tender and was connected to a similar pipe under the entire length of the first car by a flexible hose. Each of the succeeding cars had a similar pipe similarly connected. This pipe was called the 'train pipe.' From the train pipe of each car a branch pipe communicated with the forward end of a cylinder called the 'brake cylinder.' This cylinder was provided with a piston, the stem of which was connected with the brake levers on the car. When the engineer wished to apply the brakes, he opened the engineer's valve and the compressed air from the main reservoir flowed back through the train pipe and branch pipes into the brake cylinder on each car, pushing the pistons backward, causing the piston stems to operate the brake levers and force the brake shoes against the wheels.

"When he wished to release the brakes, he so shifted the valve as to shut off the flow of compressed air from the main reservoir, and to open a port or vent leading from the train pipe to the open air. Thereupon the compressed air in the brake cylinders escaped into the open air, the pressure of the pistons was removed and the pistons were forced forward again by means of springs, thus moving the brake shoes away from the wheels.

"The validity of this patent was sustained in *Westinghouse vs. Gardner & Ransom Air Brake Company* (9 O. G., 538).

"The operation of this plain brake was open to certain objections. It was too slow, and was attended by danger of collision in case one part of the train became detached from the other part.

"The brake next to be considered is known as the 'automatic brake,' which appears to have been patented by George Westinghouse, Jr., about 1872 or 1873.

" It embodied the addition of an auxiliary reservoir and a triple-valve device to each car. Each reservoir was of sufficient capacity to operate its brakes once, thus to provide for automatic action in case of accident. The triple-valve device was located at the junction of connections between pipes leading to the train pipe, the brake cylinder and the auxiliary reservoir. In addition to these three ports, there was a fourth port leading to the open air.

" The operation of this brake was radically different from that of the 'plain brake.' In the former, the compressed air was stored in the main reservoir until required for the application of brakes. In the latter, the main and auxiliary reservoirs and train pipe were always charged with compressed air at working pressure, to prevent the application of the brakes. When the engineer wished to apply the automatic brake, he shifted the engineer's valve so as to cut off the flow of compressed air from the main reservoir and open a port from the train pipe to the open air. The effect of this was to reduce the air pressure in the train pipe, and cause a back pressure from each auxiliary reservoir through the triple valve, which shifted it so as to close the port from the branch pipe to the train pipe, and stop the escape of air from the auxiliary reservoir, to close the port leading from the brake cylinder to the open air, and to open the port leading from the auxiliary reservoir, and connect it with the port leading to the brake cylinder. Thereupon the compressed air in the auxiliary reservoir flowed into the brake cylinder and applied the brakes.

" It will thus be seen that, while the former system was operated by pressure from the main reservoir, the latter was operated by withdrawal of pressure. The result was automatic action in case of accidents, whereby air was caused to escape from the train pipe, as by bursting of hose or the train breaking in two. In such cases the release of pressure operated the triple valve, and automatically applied the brakes.

" It is necessary here to consider 'train-brake graduation' or 'service stops,' as distinguished from 'emergency stops.' While for the latter it may be necessary to admit to the brake cylinder the full pressure of compressed air, say seventy or eighty pounds, yet where it is desired merely to slow up without stopping, it may be necessary to admit only, say, ten or twenty pounds, graduating the amount of flow according to the character of service desired. It is important to bear this distinction in mind, because the appliances hereafter to be considered have been so devised as to provide therefor, and that such graduation shall be under the control of the engineer.

" The chief objection to this automatic brake lay in the fact that it was not capable of successful operation on long trains of freight cars. The time consumed by the progressive operation of the brakes between the grip on the first and last car allowed of so much slack motion between them as to cause violent shocks.

" This automatic brake was publicly tested near Burlington, Iowa, in 1886.

" The growing importance of the subject of automatic freight graduation, the inadequacy of existing systems to protect the lives of railroad employees, and the disastrous results therefrom, had become so evident that, in 1885, the Railway Master Car Builders' Association arranged for series of experiments, known as the 'Burlington trials.'

" The Westinghouse Company and several other companies engaged in the manufacture of brake apparatus, competed at these trials.

" None of the competitors succeeded in stopping long trains of freight cars without violent and disastrous shocks.

" In 1887 the trials were renewed. There were five competing parties, including one of the leading experts for the defendants, and the complainant company. The latter then presented an improved apparatus, covered

by Patent No. 360,070, granted to George Westinghouse, Jr., March 29, 1887.

"The report of the committee of the Car Builders' Association shows that they considered 'the field for improvement open as wide as in 1886,' and concluded that air brakes actuated by electricity were the only ones likely to be capable of successful operation on long trains of freight cars. The improved Westinghouse apparatus, while it reduced the length of time between the application of the first and last brakes, produced greater shocks than did the automatic apparatus of the preceding year.

"In this condition of affairs, George Westinghouse, Jr., set himself to work to obviate these difficulties. Upon the conclusion of the 1887 trials, he renewed his investigations and experiments, and, by certain changes and improvements in the old apparatus and the introduction of new elements, he succeeded, in the latter part of the year 1887, in constructing a quick-action automatic brake, capable of being successfully applied to a train of fifty freight cars, and operative under all conditions of practical railway service.

"On October 1st, 1887, he applied for a patent for this apparatus, and, on January 24th, 1888, the patent was granted. Said Patent, No. 376,837, is the first of the patents in suit.

"Before proceeding to consider in detail the claims of this patent, it should be stated that the following were among the requirements for the practical operation of air brakes :

"1. The regulation of the force to be applied to the brake-shoes so as to secure all necessary graduations, from the mere slackening of speed to the service stop, and from the service stop to the emergency stop.

"2. The automatic operation of the brakes in case of accident.

"3. The practically simultaneous operation of the brakes on each car so that, in long trains of freight cars, shocks might be avoided.

"4. The control of all these operations by the engineer.

"5. Certainty of operation under all conditions."

The automatic brake system constructed in general accordance with the invention described in No. 376,837 complies with all these essential conditions. It was unquestionably the first system which practically solved the problem of immediate stoppage of a long freight train in time of danger, in connection with and supplemental to "train brake graduation," and so promptly was its success recognized that 125,000 of this kind of brakes were bought and used by the railroad companies of this country within a period of little more than three years. It is, therefore, important to understand the nature of the improvement which created success.

The promptness with which an automatic air brake system could be made effectual, depended upon the promptness with which air pressure in the train-pipe could be reduced and the equalization of pressure could be changed. Before the series of inventions originated by the Burlington trials, this reduction had been effected in passenger trains of ordinary length by "venting" the train-pipe or opening a port from the train-pipe to the open air, which was initiated by a turn of the engineer's valve on the locomotive. Westinghouse, in his attempt to create efficient and immediate service upon each car of a long train, enlarged the venting system, so that, when the reduction of train-pipe pressure had commenced by the turn of the engineer's valve, the triple valve under each car should also vent the train-pipe of that car. Each car, therefore, contained its own venting mechanism, and, as the mechanism did its work upon its own car, it hastened the work upon the car next in the rear. Westinghouse also sought to save, and did save, power, by compelling the compressed air thus vented to pass into the brake cylinder instead of into the open air. But sudden and large reduction of pressure is only to be used in a case of emergency, and, therefore, means for such re-

duction must be made supplementary to the means for the ordinary service of the brakes, so that ordinary and extraordinary use of the brakes can each be made available as necessity arises.

The method in No. 360,070 was to make the ordinary range of motion of the triple-valve piston, which was produced by a reduction of train-pipe pressure of a few pounds, do the ordinary work of "braking" a train, and to make an extraordinary range of motion throughout the entire length of its capacity for travel, which was produced by a reduction of fifteen or twenty pounds, do the extraordinary work which gave to the brake the name of "quick-action." When the piston of the triple valve moved through the entire length which it could travel, the stem of the piston came in contact with the stem of the emergency valve, opened it, which uncovered a port, and thereby the train pipe pressure was vented into the brake cylinder. The claims of the patent call the first or ordinary range of motion of the piston "a preliminary traverse," which admits air from the auxiliary reservoir to the brake cylinder, and the second range of motion "a further traverse," which enables the piston to admit air directly from the main pipe to the brake cylinder.

This invention, palpably and confessedly, lacked success in the Burlington trials. The reason of its failure and its remedy in No. 376,837 are described by Mr. Massey, a competent expert for the defendants and the patentee of the infringing valve, whose testimony upon this subject is admitted to be correct. He said, upon direct examination, in reply to the question: "What is the practical objection, if any, to the quick-action triple valve of 360,070, and how is that remedied by the apparatus of 376,837? Before answering, state what is meant by the 'Westinghouse Quick-Action Automatic Brake.'"

"Ans. The term 'Westinghouse' Quick-Action Automatic Brake,' as used by Mr. Stone, undoubtedly refers to the quick-action triple valve described in Patent

376,837, and illustrated on sheet 2 of that patent. It is also the quick-action triple valve which is illustrated in the Westinghouse catalogue of 1890.

"In the quick-action triple valve described in 360,070, in addition to the triple valve, the stem of the piston came in contact with an emergency valve, and the extreme motion of the triple-valve piston caused the emergency valve to open a small passage between the train pipe and the brake cylinder, thus causing a local exhaust of the air from the train pipe, and, therefore, reducing the pressure in the train pipe quicker than would be done by the vent through the engineer's valve. The port which was opened by the emergency valve was necessarily restricted in size, as, in order to be effective, the piston of the triple valve must be able to open it within a moderate reduction of train-pipe pressure, and, therefore, with but little force in addition to that consumed by the piston in moving the ordinary triple-valve mechanism. If the emergency valve had been arranged to open a very large port, the time required to exhaust the train pipe through the engineer's valve, sufficiently to allow the piston to open the emergency valve, would be materially increased.

"This defect in the emergency valve of 360,070 would not be serious in trains of moderate length, as under, say, twenty-five cars; but in the 50-car train used at Burlington, in May, 1887, the effect was disastrous. This defect is remedied in 376,837, by using a supplemental piston to open the emergency valve and actuating that piston by fluid pressure from the reservoir through a passage controlled by a valve which is actuated by the triple-valve piston. In this case the triple valve system has only to open a comparatively small port, in addition to its regular function, and fluid pressure in the auxiliary reservoir then causes the supplemental piston to open the emergency valve."

The length of time required, in the use of the single valve of Patent No. 360,070, to open a sufficiently

large port, above referred to, appears to have been in the mind of Westinghouse in providing a separate piston of the patent in suit to open the emergency valve ; for, in the description of this improved invention, it will be remembered, he states that " its object is to facilitate the application of brakes with great rapidity and full or approximately full force, as, from time to time, required, by the provision of means whereby the admission of air from the brake pipe to the brake cylinders may be effected as directly as practicable, and through passages of as large capacity as may be desired."

No. 376,831 abandoned reliance upon the piston of the triple-valve as the means of opening the emergency valve, and used a supplementary piston, contained in a supplementary chamber and actuated by pressure from the auxiliary reservoir. The port, through which, when uncovered, this pressure passes, is, in the mechanism shown in the specification, uncovered by the excess stroke of the triple-valve piston. The description of the mechanism, which is contained in the next paragraph, is in the language of the opinion in the Circuit Court, and, inasmuch as the intricate mechanisms of the various devices which are the subject of discussion in the three cases, now grouped together, were accurately described by Judge TOWNSEND, his language will be used, instead of attempting to formulate independent descriptions of the same series of devices : " This emergency action is secured in the patent in suit by means of a separate supplemental piston and valve in a supplemental valve chamber below the main slide valve of the triple-valve device. This chamber connects the train pipe with the brake cylinder, communication between them being regulated by the supplemental valve, opening outwardly or downwards, and a check valve opening inwardly or upwards. These valves are held upon the seats, under ordinary conditions, by a spring bearing upon their stems. In the bushing which forms the valve face of the main slide valve are four ports governed by said slide

valve. One of these ports leads to the brake cylinder, two lead to the supplemental-valve chamber on the upper or inner side of the supplemental piston, and one leads to an exhaust port.

"When an emergency stop is to be made, the engineer throws his engineer's valve wide open, thereby causing a sudden and material reduction of pressure. The excess of auxiliary reservoir pressure then forces the main piston stem against said other stem, overcoming the tension of its spring, drives the main piston to the extreme limit of its stroke, and thereby uncovers the ports leading from the auxiliary reservoir to the supplemental valve chamber. This pressure drives the supplemental piston outwardly, or downwards, against the stem of the supplemental valve, and forces it from its seat.

"Thereupon the preponderance of train-pipe pressure in the brake pipe opens the check valve, and the air from the train pipe rushes directly from the brake pipe to the brake cylinder.

"The result of this operation is two-fold. It hastens the application of the brakes on the car on which it is operated, and, by venting the train pipe, it hastens a similar reduction of pressure and consequent similar operation in the next succeeding triple-valve device on the next car.

"The release of the brakes is accomplished by the admission of air from the main reservoir."

The three claims which were found to have been infringed are as follows :

"I. In a brake mechanism, the combination of a chamber or casing having direct connections to a brake cylinder and to a brake pipe, respectively, a valve controlling communication between said connections, and a piston or diaphragm which is independent of, and unconnected with, a triple-valve piston, and is actuated by pressure from an auxiliary reservoir in direction to impart opening movement to said valve, substantially as set forth."

" II. The second claim includes 'a check or non-return valve controlling communication between said valve and the brake-pipe passage of the chamber, substantially as set forth.'

" III. In a brake mechanism, the combination, with a triple-valve, of a supplemental chamber or casing having passages leading to a brake cylinder and to a brake pipe, respectively, a supplemental valve, controlling communication between said passages, a supplemental piston operating independently of the triple-valve-piston, and adapted to impart opening movement to said supplemental valve, and a passage establishing communication between said supplemental piston and an auxiliary reservoir, substantially as set forth."

The vital parts of this mechanism are the supplemental chamber, having direct connections to the brake cylinder and the brake pipe, the valve 41, which controls communication between these connections, the emergency piston 63, independent and unconnected with the triple-valve piston, and actuated by pressure from the auxiliary reservoir in a direction to impart opening movement to the valve. To these essential parts, the defendant would add another, the particular means by which, in the specification, the emergency piston is actuated, viz.: the excess stroke of the triple-valve piston which uncovers the port 61, through which the auxiliary-reservoir pressure passes. Upon the scope of the invention, the question of infringement depends. The defendant insists that the only invention "resides in the use of an emergency piston, which is open to the exhaust port on one side and to the brake cylinder on the other side, and which is not subject to operative pressure from the reservoir, except by the extreme stroke of the triple-valve piston." The assignments of error are confined to this question, and the consequent construction of the first three claims, and to the question of infringement.

The defendants' theory mistakes the character and scope of the invention, which was another and successful way to accomplish the work designed to be accomplished by No. 360,070, and to be effected, upon the same general plan of instantaneous brake-pipe venting, by the new means contained in the supplemental chamber which have been named.

In No. 360,070 the stem of the triple-valve piston directly engaged with the stem of the emergency valve, and consequently its action directly depended upon the movement of the piston. The invention in 376,837 radically departed from this method of actuating the emergency devices, by making a new piston, independent of and unconnected with the triple-valve piston. It was to be actuated by auxiliary reservoir pressure, but the particular means by which this pressure was to be permitted to exert itself, whether continuously or only when a port should be opened, do not constitute an essential part of the invention. Means must necessarily be shown in the specification, but the identical means or the special devices were not, in the language of *Morley Machine Co. vs. Lancaster*, 129 U. S., 263, "necessary constituents" of the invention, either in the specification or in the claim. The skill and mechanical ingenuity of constructors of locomotives can, as will be seen hereafter in the examination of other patents and of the infringing devices, arrange different details of mechanical construction, by means of pistons, valves, ports and springs, which, adopting the supplemental chamber system first conceived and embodied by the patentee, and a kindred, but not precisely the same, mechanical method for the movement of the piston, will accomplish the same result. The patentee was a pioneer in that he designed, in No. 376,837, a new way to accomplish a desired result, but upon the same general idea which he had unsuccessfully tried to work out in the earlier patent. His later patent was the bridge, and not a mere step, which carried railroad-car builders

from failure to success. It is not important now to determine the grade of its pioneership, and whether it may be classed in the list of those inventions which are of the highest rank, but it was an invention created to achieve great necessities and overcome great hindrances, and was one of wide breadth. A court would not be justified in adopting "a narrow or astute construction" which should minimize the character of the invention, leave its real scope open to trespassers, and thus "be fatal to the grant." The claims of the patent do not contract the grant to narrower limits than those which the invention as made by the patentee actually covered, and the claims, therefore, are not limited to the precise mechanical means described in the specification, by which the supplementary piston is actuated. They compel it to be disconnected with and to be independent of a triple-valve piston, and to be actuated by pressure from an auxiliary reservoir by some means equivalent to the means which are described in the specification. The rule, which permits and indeed compels courts to give a wide range to the equivalents which a broad or pioneer patent can include, is thus expressed in *Miller vs. Eagle Mfg. Co.*, 151 U. S., 186: "If the invention is broad or primary in its character, the range of equivalents will be correspondingly broad, under the liberal construction which the Courts give to such inventions."

The defendant uses two forms of devices, known respectively in the case as "Defendant's Quick-Action Triple Valve" and "Defendant's Modified Quick-Action Triple Valve." Each has the supplementary chamber with its contents and in each the various elements conform to the general phraseology of the claims, but in neither does the movement of an emergency piston have any relation to the extreme movement of the triple valve piston, and herein is contained what is claimed to be the essential difference between the patented device and the defendant's valve. In the defendant's "Modified Valve" the pressure upon op-

posite sides of the emergency piston, numbered 13, which corresponds in function with emergency piston 63 of the patent, is always counterbalanced when quick action is not desired, whereas emergency piston 63 of the Westinghouse valve is not subjected to auxiliary pressure until its action is required, when port 61 is uncovered.

In the Defendant's Modified Valve, train pipe pressure is reduced when quick action is wanted, the auxiliary reservoir pressure becomes controlling, forces down emergency valve 20, which corresponds in function with the Westinghouse emergency valve 41, and which, when unseated, opens direct communication between the train pipe and the brake cylinder. This difference between the means which are used to actuate the pistons is not of a patentable importance. The operative features of the invention which are described in the three claims are the same, whether auxiliary pressure is permitted to exert itself continuously or intermittently when a port is opened.

The defendant's earlier device uses two pistons, the first, No. 13, is forced down by auxiliary reservoir pressure, but does not act directly upon the emergency valve. When forced down "it opens a port, whereby train pressure is admitted to the upper side of the other piston (No. 17), which, being thereby forced down, imparts opening movement to an emergency valve leading to the brake cylinder."

It is true that piston 13, which is the one actuated by auxiliary reservoir pressure, does not directly and of itself impart opening movement to the emergency valve, but uncovers a port which admits train-pipe pressure to the brake cylinder, and it is true that piston No. 17 is actuated by the train-pipe pressure thus admitted. These two pistons do the work of the one piston of the defendant's modified valve. Auxiliary reservoir pressure moves the piston which, through the intervention of piston 17, imparts opening movement to the emer-

gency valve. Mr. Massey states the difference between the two valves of the defendant to be that, in the "Quick Action Triple-Valve," the initially operating piston 13 actuates the emergency valve indirectly; that is to say, through the intermediation of the piston 17; while, in the other valve, the initially operating piston 13 actuates the emergency valve directly, as in Patent 376,837." This is not a material difference of a patentable character when considered with reference to this patent, and the result is that each of the defendant's valves is an infringement. The "quick-action valve" infringes the first three claims, while the second form, not having the additional check valve of the second claim, infringes the first and third claims.

No. 448,827 will next be considered. The form of automatic air brake apparatus shown in this patent was originally included in the application for No. 376,837, which also included the form which has been already described, in which port 61 was uncovered by the excess stroke of the triple-valve piston. But the applicant was precluded, by a rule of the Patent Office, from adding to his generic claims a specific claim for the form which is now described in No. 448,827, and therefore a subordinate patent was applied for.

The details of the device are described by Judge TOWNSEND, as follows:

"The alleged invention consists of a valve, controlling communication between a supply passage from the train pipe and a delivery passage to the open air or a brake cylinder. This valve is held in position by a spring, so as to close ports leading to the delivery passage, and not to be moved from its seat by ordinary reductions of pressure for service stops. There is also a diaphragm and valve stem, interposed between the supply passage and a passage to a special reservoir or an auxiliary reservoir. Said controlling valve is connected to said valve stem. Train-pipe pressure passes through a small passage in said diaphragm into said

reservoir, thus equalizing pressure on the opposite sides of said diaphragm.

"Upon a sudden reduction of pressure, sufficient for an emergency stop, the excess pressure on one side of said diaphragm moves it and its valve stem and the said controlling valve downwardly, so as to open said ports and allow the compressed air to pass through the delivery passage to the open-air or brake cylinder."

The two claims of the patent which are said to have been infringed by the defendant's two valves, which have been before described, are as follows :

"1. In a fluid-pressure brake apparatus, normally operated by a triple-valve device, the combination with such an apparatus of a valvular appliance having a casing, provided with supply and discharge passages or connections, and a valve, controlling an exhaust port from the supply passage to the discharge passage, for quickly releasing pressure in the supply passage, said valve being actuated to open the exhaust port by a greater than normal reduction of pressure in the supply passage, independently of the action of the triple-valve device, substantially as set forth.

"2. The combination with a triple-valve mechanism of a discharge valve controlling an exhaust port from a supply passage to a discharge passage for quickly releasing the pressure in the supply passage, said valve being actuated to open the exhaust port by fluid pressure in an auxiliary reservoir on reduction of pressure in the supply passage below the normal degree, in whatever position the slide valve of the triple-valve mechanism may be brought by such reduction, substantially as set forth."

Infringement of these claims is admitted, and the only question is in regard to their validity.

The distinctive feature of the alleged invention is that the emergency valve is actuated to open the exhaust port "independently of the action of the triple-valve device."

The theory of the complainants is that, whereas the leading characteristic of novelty in Patent No. 376,837 is the "utilization of auxiliary reservoir pressure operating a supplemental piston in proper direction to impart opening movement to the emergency valve," the invention of No. 448,827 was the means of imparting movement to the valve by "auxiliary pressure, so applied that the action or non-action of the triple-valve piston shall be eliminated as an element of control," and that its distinctive feature was "the removal from the apparatus of all *obstructive* mechanical connection between the triple piston and emergency valve, whereby the latter may be impeded in its movements by the former."

This theory omits an important characteristic of the novelty of No. 376,837, which is the independency and disconnection of the supplemental piston from the triple-valve piston. In the form left in the application for the patent, after the divisional application was made, there was no mechanical connection between the two pistons, but the stroke of the triple-valve piston exercised a control over the movement of the supplemental piston, by uncovering the port which admitted auxiliary reservoir pressure. The form in 448,827 permits, as do the defendants valves, auxiliary reservoir pressure to be present at all times and to act upon the piston, but counterbalanced during ordinary service stops. It was included in the generic claims of No. 376,837, and in view of those claims no invention could consist in the mere fact of the elimination of the action of the triple-valve piston as an element of control. When the patentee obtained the broad claims of No. 376,837, he exhausted his power to obtain additional patents for mere modifications of means by which the piston should be made independent of the triple-valve piston, unless the modification contained a patentable improvement upon the form disclosed in that patent. For any new and useful improvement which contained also

the element of invention, or for a separate invention, a subordinate patent could be obtained.

Were the changes made in 448,827, after the idea of 376,837 had been embodied in its original form, the work of invention? So far as the first two claims are concerned, the changes consisted in a port from the auxiliary reservoir to one side of the emergency piston, which port was always open, and the counter-balance to reservoir pressure by a spring on the opposite side of the piston so that ordinary variations of pressure would not destroy the equilibrium necessary to be maintained until excessive reduction of pressure should take place. In view of the various forms and modifications and improvements of automatic brakes and brake-mechanism, which had been made known before the date of this invention and which are a part of the record in these three cases, there was no patentable invention in this modified form, apart from the invention shown in No. 376,837. It was simply what the patentee first deemed it to be, a form of the invention of that patent and covered by it. The first two claims of No. 448,827 contain no patentable improvement upon the form specifically described in the claims of its predecessor and are void.

We omit any description of the other grounds upon which the invalidity of these claims is placed by the defendant.

No. 393,784. This patent is subordinate to 376,837. The device which it describes has the supplemental chamber with the emergency piston and valve, and the important elements of the Westinghouse Patent, except that the emergency valve is moved by train-pipe pressure, instead of by auxiliary reservoir pressure.

"This result was accomplished by providing a separate emergency piston and valve, ordinarily exposed to train-pipe pressure above said piston, which pressure served to hold the valve on its seat, and was not affected by ordinary reductions of pressure for service stops.

But the considerable reduction of pressure necessary for an emergency stop caused air from the train-pipe to be vented into the space below said piston, equalizing the pressure on both sides and, acting on the under side of said valve, causing it to be unseated and to thus allow the train-pipe pressure to be vented directly into the brake-pipe cylinder."

The claims said to be infringed are as follows :

"1. In a brake mechanism, the combination of a valve controlling the direct passage of pressure from a train-pipe to a brake cylinder, a piston connected to said valve and actuated wholly by train-pipe pressure, and a valve controlling the train-pipe pressure on the piston for opening and closing the communication between a train-pipe and a brake cylinder through the direct action of train-pipe pressure, substantially as specified.

"2. In a brake mechanism, the combination of a train-pipe, a brake cylinder, an interposed chamber communicating with the train-pipe and brake cylinder, a piston in said chamber, a piston stem, a valve on the piston stem controlling the passage from the interposed chamber to the brake cylinder, and a controlling valve and passages for the admission of pressure from the train-pipe to move the piston and open the valve, substantially as and for the purposes specified."

The emergency piston 13 in the defendant's "Modified Valve" is actuated wholly by reservoir pressure, and this valve is, therefore, not claimed to be an infringement. The emergency piston 13 in defendant's "Quick-Action Valve" is forced down by reservoir pressure, but when it is pressed down it causes train-pipe pressure to be admitted, which acts upon and presses down piston 17, whose spindle presses upon and unseats the emergency valve. Inasmuch as the valve is disconnected from piston 17, it is returned to its seat when train-pipe pressure is removed from the upper side of the piston, mainly by the elastic force of a spring.

This patent is a subordinate one and must receive a narrow construction. It is not permissible to give to the terms of a patent of that class so wide a sweep as to include the various devices which may actuate an emergency valve in a supplemental chamber by train pipe pressure, and the range of its monopoly is a limited one. The language of each claim indicates that a connected valve and piston were to be employed, and Park's method of opening and closing the valve required that they should be mechanically connected. A mechanical connection would not be indispensable, unless there was a necessity for it, or unless a mechanical separation created a difference in the means by which the result was accomplished, which, in view of the narrowness of the invention, was a radical difference. The Park piston holds the valve to its seat, in the normal condition of pressure. It is lifted up when the valve is lifted by train-pipe pressure, and, when extraordinary pressure is removed, it restores the valve to its seat. It does not unseat the valve. The defendants' piston does not hold the valve to its seat and does not restore it to its place. When train-pipe pressure comes upon the upper side of the piston and forces it down, it unseats the valve, and, after pressure has been removed, the spring, as it resumes its shape, returns the valve to its seat. The difference in the way in which the two pistons accomplish the general result would not be a substantial one in a primary patent. It is substantial with respect to an invention which merely substitutes train-pipe pressure for the auxiliary reservoir pressure which Westinghouse used. The Circuit Court properly held that neither claim was infringed.

No. 172,064. The invention of this patent was an improvement upon the improvement patented to Mr. Westinghouse by Patent No. 168,359, and was a part of the brake apparatus used before the invention of the quick-action brake. It related to the direct admission

of air from the brake pipe to the brake cylinder. The defense that the defendant uses the original and not the later improvement was satisfactorily sustained. The peculiarity of the patented invention and of the device used by the defendant is shown in Judge TOWNSEND'S description, as follows :

“ Patent No. 168,359 provides for a piston and slide valve, so arranged that air pressure transmitted through the train pipe shall pass on the under side of the piston, and hold it in an upward position, and thence pass through a side port in the piston-valve case, and certain other ports and passages, into the auxiliary reservoir.

“ The effect of this pressure is to hold the slide valve in position above two connected ports, one leading to the brake cylinder, the other to the open air, so that any pressure in the brake cylinder will escape to the open air, and the brakes will be off. When the pressure is reduced, in order to apply the brakes, the back pressure from the auxiliary reservoir depresses said piston so that it passes down and closes the supply ports and shifts the slide valve, so as to open the port leading to the brake cylinder and exposes it to auxiliary reservoir pressure, and so as to close the port leading to the open air.

“ In Patent No. 172,064, the inventor dispensed with said side port in the valve case and substituted therefor a port through the piston itself. The piston was so arranged, in connection with this port, that said port could be opened or closed without moving the slide valve. This was accomplished by having the stem of the piston fitted to the port in the piston, so that it would close the port when moved into it and open it when removed, and by further providing that the slide valve should be made shorter than the distance between the collars on its stem, thus insuring the necessary slack motion for closing the supply port before the slide valve begins to move.

" Claim 3 is as follows :

" 3. The slide valve H, made shorter than the distance between its end bearings, in combination with the port *s* and stem *c*¹, or relatively arranged with reference to the operation of the valve H while the port *s* is closed, substantially as set forth.

" Defendants' device, as illustrated by 'Defendants' plain triple valve,' contains the slide valve, made shorter than the distance between its end bearings, on the piston stem. It is also provided with two ports, one of which leads from the train pipe, through the piston chamber and by other passages to the auxiliary reservoir. The other port leads from the auxiliary reservoir to the brake cylinder. This port is closed by having the end of the piston stem slide on to it and cover it, like a valve upon its seat.

" There is no port through defendants' piston, and, consequently, no piston stem fitted to enter such port."

The claim is for the valve made shorter than the distance between its bearings with the specified improvements upon 168,359, viz. : the air port through the piston, which is opened and closed by the stem. The effect of this arrangement is stated in the specification, as follows :

" The port *s* will be closed before the valve H begins to move for applying the brakes, and will be kept closed until the valve H shall have been brought back to the proper position for a full release of the brakes. Consequently, the valve H can be operated as may be desired in applying and releasing the brakes and in graduating the brake pressure, without leakage or loss at the air-supply port *s*, and with such port always closed."

It is undoubtedly true that the two devices accomplish the same result and close the supply port before the valve begins to move, but infringement can only be found by giving a construction to the third claim, which disregards the fact that No. 172,064 substitutes the air port *s* with its plug *c* for the side port of 168,359.

The conclusion which the Circuit Court reached was the correct one.

It was stated as follows :

"Inasmuch as complainants claim a combination which contains a port through the centre of a piston, described as substituted for a side port, with which said improvement dispenses, and as defendants' device depends upon the use of a side port, and has no port through the piston, but is made up by a combination of different elements, which are admitted in Patent No. 172,064 to be a part of the prior art, the combination claimed in claim 3 of said patent is not infringed.

"A correct construction of the claim must include the port through the centre of the piston, substituted for the side port of Patent No. 168,359."

The invention of No. 222,803 was an engineer's valve, which, speaking in very general terms, should, by the movements of a single stem or lever, admit and automatically stop admitting fluid pressure to the brake pipes, by means of a charging valve, automatically retain such pressure and permit its escape by an exhaust valve, with means for automatically closing either valve when the desired pressure had been charged into or withdrawn from the train pipe to which the device was connected.

The patentee summarized, in his specification, his invention, as follows :

"It will now be seen that I provide for operating both the supply and the exhaust valves by a single stem, that only one can be opened at once, that either may be opened separately (much or little), and that both may be closed simultaneously and automatically and kept closed whether the brakes are on or off."

This automatic closing of the charging and exhaust valves was a very important part of the invention.

The patented valve, so far as the second, third and fourth claims are concerned, "consists of piston case, containing a piston, governing a charging valve held up

to its seat, partly by fluid pressure and partly by a spring, and an escape valve held down to its seat, partly by gravity and partly by a preponderance of fluid pressure on its upper end.

This governing piston is exposed on its under side to fluid pressure, and on the upper side to pressure from a spring. A screw-stem worked by a crank-arm, is so arranged in connection with said spring that, by the revolution of the crank-arm, the downward pressure of said spring upon said piston is increased or lessened.

The effect of such change of pressure is to cause the piston to be moved upwards or downwards according as it is acted upon by an excess of fluid or of spring pressure, and to open or close the charging and escape valves.

Beneath the lower end of the escape valve, provision is made for a certain amount of slack motion, so that the governing piston may be moved up or down for a short distance without unseating the escape valve. The effect of this arrangement is to prevent the possibility of both valves being open at the same time.

The operation of said apparatus is as follows :

In order to apply the brakes or to open the charging valve, the crank arm is screwed down, and this increase of pressure, transmitted through the stem of the piston-head to the charging valve, unseats it and permits fluid pressure to pass from the boiler or storage reservoir to the train pipe and brake cylinders.

The fluid pressure also passes upward to the space below the piston head and exerts the same pressure upon it as in the train pipe or brake cylinders.

The engineer knows, from his engineer's gauge, just how far to screw down his crank, so that, when the necessary amount of pressure has passed through to the train pipe or brake cylinder, the same pressure will automatically lift the piston and close the charging valve.

The crank arm is screwed up in order to open the escape valve, and, after the proper amount has been

discharged, the escape valve automatically closes in the same way as already shown in the case of the charging valve.

The three claims which the Circuit Court found were infringed are as follows :

"2. As a means for automatically cutting off the fluid-pressure supply when the desired pressure has been charged into the brake cylinders, a piston head P, movable by the operative brake pressure or any excess thereof, in combination with the charging valve and a connection from one to the other, substantially as set forth, whereby such movement of the piston head will result in the automatic closing of the charging valve, substantially as set forth."

"3. The combination of piston head, charging valve, interposed stem and escape valve, substantially as set forth, with reference to the opening and closing of the charging valve, without necessarily opening the escape valve, substantially as set forth."

"4. The combination of piston head, charging valve, interposed stem, escape valve and a single operating stem, adapted by independent connections with both valves to shift both by independent successive motions, substantially as set forth."

The defendants' valve has a single lever which is moved from side to side by a single handle having a reciprocating motion. The valve has also a piston exposed to fluid pressure on both sides, which controls a charging and an escape valve, which perform the same functions as in the patented valve.

"The main lever, which is fastened to said handle, carries an eccentric pin, which passes through said lever, and which moves in the arc of a circle. The right end of the lever is held stationary by a jaw and fulcrum pin; the left end, when said handle is moved to the right, is lifted by the rock-shaft motion imparted by said pin, and strikes against another pin, attached to the escape valve, and raises and opens said escape valve. This lever has

also an upper jaw, which moves in a pin attached to a bell-crank lever, the arm of which is directly beneath the charging valve. In order to open this valve the handle is moved to the left, which causes the main lever and pin to move to the left, and to raise the arm of the bell-crank lever and open the charging valve. Provision is made for slack motion by a space between the top of the escape valve and said pin attached thereto, whereby the left end of the main lever is permitted to have a certain amount of play before it strikes said pin."

In addition to fluid pressure, the piston is "acted upon from below by a bell-crank lever, or bent lever with vertical arms, connected by links to the piston, and to a second lever, which second lever is connected with a light spring."

An attempt was made in the testimony to claim that the patented valve lacked novelty, or that its descent could be traced from Patents No. 129,015, dated July 16, 1872, issued to Fay & Cairns, and No. 141,685, dated August 12, 1873, issued to George Westinghouse, Jr. The Fay & Cairns Patent was for an apparatus for regulating the flow of water in houses and shutting it off when there is an excess of pressure, so as to prevent the bursting of pipes. The Westinghouse Patent was for a triple valve and it was admitted in the course of the testimony that the patent described nothing designed for or capable of performing the functions of the engineer's valve. The Fay & Cairns invention was a pressure regulator, contained no exhaust valve, and could not be an engineer's valve. The idea that either of these patents anticipated or restricted the patentable character of the whole invention is not now entertained. The defendant is, however, of opinion that No. 141,685 is an anticipation of the second claim. The importance of this suggestion will be considered hereafter.

The invention, as a whole, is thus conceded to be without a predecessor, and the importance of an inven-

tion by which both valves could be automatically closed upon the desired amount of pressure being charged into or exhausted from the train pipe is manifest.

The object of the defendants' valve is by the movement of a single handle to accomplish the same results which the patented valve attains, and it is conceded that the valve has a piston head, movable by operative brake pressure or any excess thereof, a charging valve, an escape valve and interposed connections so arranged that the charging valve may be opened and closed without necessarily opening the escape valve, a connection between the piston head and charging valve, consisting of a bell-crank lever, a pin and lever and a projection on the piston head, and that by reason of this connection a movement of the piston head under the operative pressure or any excess thereof, will result in the automatic closing of the charging valve.

But it is contended that the second claim of the patent is void by reason of the Fay & Cairns Patent, that the defendants' valve has not the interposed stem of the third and fourth claims, because the motion of the complainants' piston always acts through the stem to open the valve, that the defendants' piston does not open the charging valve as required in the third claim and does not open either valve, except only that the pin carried by its piston is the fulcrum of the lever when the escape valve is opened, whereas, neither of the valves in 222,803 can be opened except by moving its piston, and therefore that the true construction of the third and fourth claims is as follows:

In regard to the third claim: "The combination of a piston for opening and closing two valves by reverse motions of the piston; those valves; and a part interposed, whereby the motion of the piston in one direction, from its position with both valves closed, opens one of the valves, and its return motion allows that valve to close, while its motion in the opposite direction opens the other valve and its return motion allows that valve to close." In regard to the fourth claim: "The above

combination, with the addition of a single handle by means of which the engineer can vary the pressure on one side of the piston."

The second claim of the Patent contained the case provided with a piston chamber and valve chamber in addition to the three elements which are specifically named.

The Fay & Cairns patent was a water pressure regulator. The specification says that it consisted of a hollow cylinder attached to a valve and communicating at one end with the water pipe into which the water flows through the valve. In the cylinder is a piston whose rod is connected to the valve, a coiled spring is behind the piston under such tension as to hold the valve open until the pressure becomes too great for the pipe beyond the valve, when the water pressure on the piston closes the valve and keeps it closed until the pressure on the piston and in the pipes falls below the power of the spring, when it will open the valve cylinder. There is no exhaust valve, but claim 2 does not include an exhaust valve, and the valve is connected with the piston, whereas, in No. 222,803 the charging valve is closed by a separate spring, but this is thought by the defendants to be immaterial in a structure not having an exhaust valve, "the purpose of separation being to permit a further upward movement of the piston so as to open the exhaust valve after the charging valve has been seated." The needs of a water pressure regulator to be attached to a water pipe which conveys water into a house, and an engineer's valve in which there must be a charging and an escape valve are very different.

In an engineer's valve, opened by a single stem, the charging valve must be separated from the piston or the device would be useless, and it is no answer to the validity of the claim to say that some other fluid-regulating device was operated by a different arrangement of valve and piston which, though it might come within the general terms of that claim, would be useless in the device which was the subject of the patent.

The great dissimilarity in form and appearance between the patented valve and the defendants' valve tends to confuse the mind when the question of the infringement of the third and fourth claims is first looked at. The defendants' valves and piston are not arranged in the same axial line, motion is not communicated to the piston in an endwise direction, but through a series of bell-crank levers, which at first seem to be operating upon a different system from that of the patent. A closer examination shows that the series of operations in the patented valve is substantially reproduced in the defendants' valve by like instrumentalities. It is not denied that the defendants' valve has a series of levers and pins which may be called an interposed stem, and which communicate motion somehow, but it is said that its piston and its stem do not correspond with these elements in the 3d and 4th claims, mainly because in the Westinghouse device the motion of the piston acts through the stem to push the valve open, and the defendants' piston does nothing to open either valve.

It is true that, in the Westinghouse valve, there is a direct connection between the piston and the charging valve, and that the movement of the piston opens the valve, and that, in the defendants' valve, the charging valve is opened by the manual movement of the handle and lever 49, and the piston, at the time, remains stationary.

By the subsequent movement of the piston, when sufficient train-pipe pressure has been admitted, the charging valve is closed automatically.

It is also said that the defendants' piston does not open the escape valve, except that the pin carried by the piston is the fulcrum of the lever when the escape valve is opened. This may also be considered as true, but it should also be said that there is an upward movement of the piston before the valve is opened.

As explained by Mr. Barnes for the complainant, the movement of the handle to the right raises the ful-

crum of the lever, which imposes upward pressure upon the piston ; it moves upward until the elastic resistance below the piston is reduced so much that the train-pipe pressure on top of the piston can lift the escape valve by means of the lever known as 43.

If the third and fourth claims require that one or both valves must be both opened and closed by the motion of the piston, and that the interposed stem must move with the piston to open one or both valves, then there is no infringement. The third claim, for example, is for the combination of piston-head, charging valve, interposed stem and escape valve with reference to the opening and closing of the charging valve. As the invention did not consist in the particular way in which the elements of this combination co-operated, in reference to the mere opening of the valve, and as the language of the claim is not limited to anything more narrow than the actual invention, the construction which the defendant seeks, is not necessary ; the only question is whether the differences which have been stated, and which are, in substance, the difference between the direct action, in the patented device, of the piston, through the interposed stem, in opening the valves and the action of the bell-crank lever, pin and lever, which are the interposed stem of the defendants' device, constitute such a departure from the means which the patentee used and described, as to constitute new and different means which escape a just charge of infringement.

The question of infringement is controlled by the principles restated in *Morley Machine Co. vs. Lancaster*, 129 U. S., 263, and confirmed in subsequent and recent cases (*Miller vs. Eagle Mfg. Co.*, *supra*), and which makes these actual differences, which would be important in a subordinate patent, unessential when a patent for a pioneer invention is under examination. If such differences should be regarded by Courts as essential, when the claims do not make the specific de-

vices essential, patents for pioneer inventions would ordinarily have but little value.

All the decrees of the Circuit Court in case No. 4976, and in case No. 4977, which have been appealed from, are affirmed with costs of this Court. The interlocutory decree of the Circuit Court in case No. 5315 is reversed with costs of this Court, and the cause is remanded to that Court with instructions to dismiss the bill with costs of that Court.

GEORGE H. CHRISTY, FREDERIC H. BETTS, J. SNOWDEN BELL, for the complainants.

J. E. MAYNADIER, FREDK. P. FISH, ESEK COWEN, EDWARD C. JAMES, for the defendants.

UNITED STATES CIRCUIT COURT,

SOUTHERN DISTRICT OF NEW YORK.

THE WESTINGHOUSE AIR BRAKE CO.

VS.

THE NEW YORK AIR BRAKE CO.

LACOMBE, Circuit Judge.

This is an application for a preliminary injunction under three patents, viz: No. 360,070, March 29, 1887, to George Westinghouse, Jr. No. 376,837, January 24, 1888 to the same, and No. 393,784, December 4, 1888 to Harvey S. Park.

It is unnecessary to enter into any elaborate statement of the history of the art, and of the impress left upon it by these inventions. That entire subject has been discussed with great care and set forth at great length in the former opinions of this Court and of the Court of Appeals delivered in the earlier actions between these same parties: 59 Fed. Rep. 581, 63 Fed. Rep. 962. In those opinions it is held that the two patents 360,070 and 376,837 disclosed, the one the emergency valve, the other the supplemental piston or special motor, which, so far as the art has now progressed, appear to be both essential to the structure of a successful quick action air-brake. Both of these inventions achieved great necessities and overcame great hindrances; each is an indispensable part of the "bridge which carried railroad car builders from failure to success"; both were products of the inventive genius of the same man; nothing anticipating either is shown; and the defense of the defendant, in the former action and in this, may truthfully be described in terms of another art:—

by bringing the two patents into juxtaposition, they seek to short-circuit the claims and thus dissipate the invention. This attempt failed in the former suit, wherein No. 376,837, the patent sued upon, was held to be one of wide breadth—one as to which “a court would not be justified in adopting a narrow or astute construction which should minimize the character of the invention, leave its real scope open to trespassers and thus be fatal to the grant”. Wherefore, the Court of Appeals held it to be entitled to a liberal construction with a wide range of equivalents. Although No. 360,070 was not declared upon in the earlier suit, it was discussed at great length and its meritoriousness was clearly recognized. The statements of the problem to be solved, as it stood prior to January, 1888, and of the contribution of 360,070 to that solution, as they are set forth in the opinions above cited, leave no doubt that both the Circuit Court and the Court of Appeals regarded it as a patent of wide breadth, the only difficulty being to find sufficient standing room within the field it occupied to permit of according to 376,837, also, the necessary breadth of construction to cover the infringing devices then before the Court, and thus save to a meritorious inventor the fruits of his novel and most useful invention.

Defendant relies upon the rejection by the Patent Office of the original first claim of 360,070 and the substitution of the present first claim, as an abandonment of the fundamental broad invention therein disclosed. When, however, the reference on which the Patent Office rejected the original first claim (Boyden's Patent, No. 280,285) is consulted, it is apparent that the essential change in the claim is the phrase used to differentiate 360,070, an invention to be used “in the application of the brake”, from Boyden's invention, whose object was to provide for replenishing, “while the brake is on”, the air reservoir or brake cylinder, when the pressure is reduced by leakage &c. There is nothing in the file wrapper or contents to show that the Patent Office required or that the inventor agreed to abandon what was

the great feature of his invention—the emergency valve, or to give up whatever range of equivalents his patent might, as modified, fairly cover.

Both these patents, 360,070 and 376,837, are broad ones, and their claims should be construed to cover the meritorious invention they disclose, unless the language of such claims precludes such a construction. The only question really open on this motion is that of infringement.

Patent No. 360,070.

The first claim of this patent is as follows:

"I. In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake cylinder, a triple valve, and an auxiliary valve device, actuated by the piston of the triple valve and independent of the main valve thereof for admitting air in the application of the brake directly from the main air pipe to the brake cylinder substantially as set forth."

Defendant's device has the main air pipe, an auxiliary reservoir, a brake cylinder, a triple valve and an auxiliary valve device, independent of the main valve, for admitting air, in the application of the brake, directly from the main air pipe to the brake cylinder. The means for actuating the auxiliary valve device is stated in the claim to be "the piston of the triple valve". And the way in which it acts, as shown in the patent, is by direct impingement upon the stem of the auxiliary valve device. In defendant's structure the piston of the triple valve acts upon the auxiliary valve device, not directly, but by opening a port, which reduces pressure on one side of another piston in a supplementary chamber, the movement of such supplementary piston opening the emergency valve. None the less is the auxiliary valve device "actuated" by the piston of the triple valve, though two pistons do the work of one, and the action of the triple-valve piston is indirect instead of direct. Such an addition to the mechanical details of the combination is within the doctrine of equivalents, when the original invention is a broad one, as this undoubtedly is, and the language of the

claim fairly covers it, which is the case here—the word “actuated” being applicable equally to indirect and to direct actuation. Nor will it avail defendants, as against the claim of a broad patent, that the addition to the mechanism is itself an advance in the art—an advance, it may be noted, which is not theirs, but one they have appropriated from a subsequent patent of the same inventor. The person who discovered the advantage of a supplemental motor for the emergency valve and devised its mechanism, was, as the Court of Appeals has held, entitled to a broad patent for that highly meritorious invention, which was essential to complete success in the art: but that circumstance did not entitle him to appropriate the meritorious and equally essential emergency valve of the earlier patent, so long at least as he actuated his supplemental motor in the way in which such earlier patent claimed, viz: by the piston of the triple valve.

The second claim of No. 360,070 is as follows:

“2. In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake cylinder, and a triple valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake-cylinder, and which by a further traverse admits air directly from the main air pipe to the brake cylinder, substantially as set forth.”

The discussion of the first claim applies equally to this one. In the first claim, actuation by the piston of the triple valve was made an element. In this claim, the inventor more closely limits the mode of such actuation. It is to be by a “further traverse” of that piston. The means shown in the patent is by direct impingement upon the stem of the emergency piston; the defendants avail of the “further traverse” to set in motion supplementary devices which act upon the emergency valve. Both these claims are infringed, as is also the fourth. The fifth, which has not been elaborated upon the argument, contains the additional element of a check valve, and the question of its infringement may be left for final hearing.

Patent No. 376,837.

The first claim of this patent is as follows:

"1. In a brake mechanism, the combination of a chamber or casing having direct connections to a brake cylinder and to a brake pipe respectively, a valve controlling communication between said connections, and a piston or diaphragm which is independent of and unconnected with a triple-valve piston, and is actuated by pressure from an auxiliary reservoir in direction to impart opening movement to said valve, substantially as set forth".

This is the "supplemental chamber system first conceived and embodied by the patentee", an invention which the Court of Appeals has held to be a broad one, and entitled to a wide range of equivalents. When we speak of anything as actuated by air pressure, the phrase necessarily implies movement in one direction or another, as the pressure is increased or diminished. Whether it is set from rest into motion by applying pressure or by withdrawing it, the phrase "actuated by pressure" fairly describes the operation.

The question whether defendant's present device infringes this claim, as did the two devices which were before the Court in the former suit, is a narrow one. The claim of the patent is so fully discussed in the decision of the Court of Appeals, that it will only be necessary to describe defendant's new device.

The supplemental piston Q, when at rest, is pressed upon from below by train-pipe pressure. It remains at rest, because the space between its face and the enclosing walls of the chamber in which it moves is filled with air of like pressure, which reaches such space from the train pipe through two narrow conduits *p* and *u* and a connection *t*. When the device is actuated, upon the excess stroke of the triple-valve piston, the connection *t* is moved, the conduit *p* is, for an instant, closed and then opened to the outer air. Thereupon, the space above the piston is voided of compressed air, and the train-pipe pressure from below, being no longer counterbalanced by pressure in the chamber above, moves

and unseats the valve. It is actuated, therefore, by the withdrawal of the air pressure from the chamber above, which, before it is thrown open to admit of such withdrawal, has been cut off from all connection with the train pipe. Pressure from the auxiliary reservoir at no time operates upon it, either to hold it at rest or to put it in motion. Defendant contends that the claim of the patent must be restricted so as to cover only supplemental devices which are actuated by pressure from the auxiliary reservoir and therefore that its present device does not infringe. The phrases "train-pipe pressure" and "auxiliary reservoir pressure" had, prior to the granting of this patent, acquired a well-known meaning in the art, and the use of one in a claim could hardly be construed to mean the other. But complainant contends that the phrase used in this claim, to describe the means for imparting motion to the supplemental piston, is not "actuated by auxiliary reservoir pressure" nor "actuated by pressures from the auxiliary reservoir", but "actuated by pressure from *an* auxiliary reservoir." If some one should reproduce every detail of the claim, with the single exception of adding a separate and additional chamber or reservoir, which was charged from the auxiliary reservoir and then cut off from it, and should use the force thus stored in that additional or supplementary chamber or reservoir for the sole purpose of imparting motion to the supplemental piston, his device would, within the ordinary use of words, contain the element of actuation "by pressure from *an* auxiliary reservoir", whether the additional chamber were contained, as a sub-reservoir, within the auxiliary reservoir proper, or was placed entirely outside of the latter. The charging of such additional reservoir, not from the auxiliary reservoir but in the same way as the auxiliary reservoir itself is charged, viz: by admitting train pipe pressure into it through a charging port and then cutting off connection with the train pipe, does not seem to involve any substantial difference. And, where the patent is a broad one, as this is, with a full range of equivalents, the

maker of such a device may fairly be held an infringer. Whether the device of the defendant contains such an additional auxiliary reservoir in the chamber P, above the piston face, is the question in dispute. For the brief moment when, after being charged, it is cut off from the train pipe it seems to be such and the compressed air which it contains to be within a broad definition of "auxiliary reservoir pressure", viz: air compressed at the locomotive and which, passing through the train pipe, has got beyond a charging port which thereafter cuts off its connection with the source of supply, and detains it as stored-up pressure to be used in an emergency.

In view of the broad construction given to 376,837 by the Court of Appeals, the defendant's device must be held to infringe this claim. Infringement of the third and fourth claims is not so clear, and those questions must be reserved for final hearing.

Patent No. 393,784.

This is the patent to Park, which the Court of Appeals held to be a subordinate one, entitled to but a narrow construction. Infringement is doubtful, and the question had best be determined upon fuller testimony at final hearing.

Complainant may take an order for preliminary injunction in conformity with this opinion.

December 27, 1894.

[ENDORSED] Circuit Court of the United States for the Southern District of New York.—The Westinghouse Air Brake Co. vs. The New York Air Brake Co.—Opinion.—LACOMBE, C. J.—U. S. Circuit Court, filed, Dec. 27, 1894, John A. Shields, Clerk.

(A copy.)

[SEAL.]

JOHN A. SHIELDS,
Clerk.

U. S. Circuit Court of Appeals,
SECOND CIRCUIT.

THE WESTINGHOUSE AIR BRAKE CO.,
Appellee,

vs.

THE NEW YORK AIR BRAKE CO.
ET ALS.,
Appellants.

Per Curiam :

We agree with the Court below that the defendant's apparatus is an infringement of the first, second and fourth claims of Patent No. 360,070, and deem it unnecessary to add anything to the opinion of Judge Lacombe. The question whether the apparatus is an infringement of the first claim of Patent No. 376,837 is too doubtful to be resolved in favor of the complainant upon a motion for a preliminary injunction, and should be reserved for disposition upon the final hearing of the cause. So far as the order appealed from allows an injunction for the infringement of this claim it should be reversed ; otherwise, it is affirmed.

Ordered accordingly.

[ENDORSED.] U. S. Cir. C. of Appeals, Second Cir.
The Westinghouse Air Brake Co., Appellee, vs. The
New York Air Brake Co. et als., Appellants. *Per Curiam.* United States Circuit Court of Appeals, Second
Circuit. Filed May 28, 1895. James C. Reed, Clerk.

(A copy.)

[SEAL.]

JAMES C. REED,
Clerk.

[3348]

PREFATORY NOTE.

One or two preliminary matters may require a word of explanation :

FIRST. The composite character of the transcript may be a surprise to the Court.

The Boyden parties, defendants below, in order to get an early hearing in the Court of Appeals, procured an *ex parte* order from Judge GORR, under which the reprinting of the record was dispensed with in the Court of Appeals, and eight composite records were made up by binding together and repaging the records used by the opposite parties on final hearing in the Circuit Court—only a few preliminary and supplementary pages being added.

See "Proceedings in the United States Circuit Court of Appeals, Fourth Circuit," at end of "Transcript," pages 1, 2 and 3.

It is in this way that the "Transcript" now before the Court has acquired its composite form or character.

It consists of :

1st. The title, index, etc., pages I.-VII., followed by an unpagcd leaf.

2d. The Westinghouse (complainants') record, as printed for use in the Circuit Court, pages 1-720.

3d. Documentary exhibits used in the Circuit Court, pages 721-794.

4th. The Boyden (defendants') record as printed for use in the Circuit Court, pages 795-1185.

5th. Documentary exhibits, pages 1186-1338.

6th. Westinghouse (complainants') proofs in reply in Circuit Court, pages 1339-1359.

7th. Opinion of Judge MORRIS in Circuit Court, decree, appeal, etc., pages 1361-1388.

8th. Next follows "Transcript of Cross-Appeal" in terra-cotta covers, pages 1-9.

9th. Lastly, and immediately following, are the "Proceedings in the United States Circuit Court of Appeals, Fourth Circuit" (pp. 1-30).

And herein will be found the opinion of the Court of Appeals, as rendered by Judge HUGHES, commencing with (p. 5) "Statement," and followed by "Opinion" (p. 15).

SECOND. The attention of the Court ought, perhaps, to be called to the fact that the petitioners herein sought to secure a stay of the mandate until the case could be presented to this Court. The motion was refused.

"Proceedings," etc., at end of Transcript, pp. 24-26.

THIRD. If, in view of the sending down of the mandate, the writ of *certiorari* ought to issue to the Circuit Court, instead of to the Circuit Court of Appeals—a matter of practice believed to be solely under control of this Court—then we need only ask further that the Court shape its remedies accordingly.

GEORGE H. CHRISTY,
For Petitioners.



Supreme Court of the United States.

IN RE PETITION

OF

GEORGE WESTINGHOUSE, JR., and
THE WESTINGHOUSE AIR BRAKE
COMPANY for a Writ of *Certiorari*.

BRIEF IN SUPPORT OF PETITION.

The Supreme Court would not now be troubled with a request for its intervention, were it not that the case, in the opinion of counsel, fully justifies, if it does not imperatively require it.

When Congress passed the Act of March 3d, 1891, establishing Circuit Courts of Appeals, and, in patent cases, made their decisions final, it was anticipated that sooner or later conflicting and irreconcilable decisions would or might be rendered. And obviously, as the effect of such conflicts, a patent valid in one Circuit might be invalid in another Circuit; and an act of infringement, if committed in one Circuit, would be enjoined as wrong, and if persisted in, would be punished as a contempt of Court; while in another Circuit the same act would be held to be perfectly lawful, proper and innocent.

It goes without saying that such a state of things, if it should arise, would be, if not intolerable, at least so objectionable that all lawful means should be resorted to, in order to cure or prevent, as the case may be.

And especially is this true, when dealing, as in this case, with patents for railway train appliances. As is well known to everybody, railway cars go everywhere. Probably there is no railway car in the country which is not liable to be used in every one of the nine Circuits into which the United States is for judicial purposes divided. And it will be safe to say that every freight car in the country—and the invention here in controversy relates chiefly to the equipment of freight cars—at some time or other during its life of service, has been, or will be, run or operated in more than one circuit.

Every freight car going from Boston to Chicago, or the reverse, will traverse five Circuits. If it goes on to California, it will then traverse *all* the Circuits, except the fourth and fifth.

If it makes the same journey via the seat of government and St. Louis, it will traverse every Circuit except the fifth. And via New Orleans, it will go through more or less of at least six and possibly seven Circuits.

Hence the very serious evil of conflicting decisions in patent cases which relates to freight cars, cannot be otherwise than obvious.

The present case involves exactly that kind of a case or question.

But it may be admitted that a *mere* conflict is not enough. If for example, the invention in question be *trivial* and of *small importance* either as regards public or private interests, the necessity for review and revision by this Court would be less urgent. Where, however, the contrary appears, and especially where the question is one confessedly involving merit of the *highest* order, and public as well as private interests of *inestimable* value, then it is believed that a case is presented which, when the decisions thereon are at variance with each other, or with the well-settled law of the land, should be brought up for review.

The present case is one of that kind—the patent being a “pioneer” patent of high merit, great utility and of inestimable value in promoting the public interest.

The primary, ground-floor patents by which Mr. Westinghouse sought to cover and protect his invention of the "quick-action" brake, are two in number—known as Nos. 360,070 and 376,837. And, as is always the case with inventions of great merit and great commercial value, both patents were extensively infringed.

The first case to be reached on final hearing was, *inter alia*, for infringement of the second patent, No. 376,837. The two patents were so closely allied that, in order to construe No. 376,837, the Court was compelled first to construe the prior or first patent, No. 360,070. This was done by Judge TOWNSEND in the Circuit Court, and his reasoning and conclusions therein were adopted and affirmed by the Circuit Court of Appeals in the Second Circuit. Both patents were broadly construed in both courts.

Westinghouse vs. New York Air Brake Co., 59 Fed. Rep., 581.

Westinghouse Air Brake Co. vs. New York Air Brake Co., 11 C. C. A., 528; 26 U. S. App., ; 63 Fed. Rep., 962.

With the proper exhibits before the Court, and by a comparison therewith of the plain import of the decision of the Court of Appeals, the fact that *both* patents were construed, could be made to appear; but this is not necessary. In a later suit between the same parties, based on a new infringement, in which both patents were included, and on a motion for a preliminary injunction, Judge LACOMEE, who was a member of the Court of Appeals when the previous case was heard and decided, summed up with great brevity and force the views of that Court as embodied in the two opinions above cited. To quote his exact language (65 F. R., 99, 100), Judge LACOMEE says :

" In those opinions it is held that the two Patents 360,070
 " and 376,837 disclosed, the one the emergency valve, the
 " other the supplemental piston or special motor, which, so
 " far as the art has now progressed, appear to be both essen-
 " tial to the structure of a successful quick-action air brake.
 " Both of these inventions achieved great necessities and over-

"came great hindrances; each is an indispensable part of
 "the 'bridge which carried railroad-car builders from failure
 "to success;' both were products of the inventive genius
 "of the same man; nothing anticipating either is shown."

* * * * *

"Although No. 360,070 was not declared upon in the
 "earlier suit, it was discussed at great length, and its meri-
 "toriousness was clearly recognized. The statements of the
 "problem to be solved as it stood prior to January, 1888, and
 "of the contribution of 360,070 to that solution, as they are
 "set forth in the opinions above cited, leave no doubt that
 "both the Circuit Court and the Court of Appeals regarded
 "it as a patent of wide breadth; the only difficulty being to
 "find sufficient standing room within the field it occupied to
 "permit of according to 376,837 also the necessary breadth
 "of construction to cover the infringing devices then before
 "the Court, and thus save to a meritorious inventor the fruits
 "of his novel and most useful invention."

That such was undoubtedly the force given to the prior Patent 360,070 by the Court of Appeals for the Second Circuit will further appear from the views which, in their first decision, they expressed of the second patent, 376,837. Of it they say (63 Fed. Rep., 962, 969):

"The defendants' theory mistakes the character and scope
 "of the invention, which was another and successful way to
 "accomplish the work designed to be accomplished by No.
 "360,070, and to be effected upon the same general plan of
 "instantaneous brake-pipe venting by the new means con-
 "tained in the supplemental chamber which have been
 "named. In No. 360,070 the stem of the triple-valve piston
 "directly engaged with the stem of the emergency valve
 "and consequently its action directly depended upon the
 "movement of the piston. The invention in 376,837 radically
 "departed from this method of actuating the emergency de-
 "vices by making a new piston independent of and uncon-
 "nected with the triple-valve piston. It was to be actuated
 "by auxiliary reservoir pressure, but the particular means by
 "which this pressure was to be permitted to exert itself,

“ whether continuously or only when a port should be opened,
 “ do not constitute an essential part of the invention. Means
 “ must necessarily be shown in the specifications but
 “ the identical means or the special devices were not, in
 “ the language of *Machine Co. vs. Lancaster*, 129 U. S. 263,
 “ 9 Sup. Ct., 299, ‘necessary constituents’ of the invention,
 “ either in the specification or in the claim. The skill and
 “ mechanical ingenuity of constructors of locomotives can, as
 “ will be seen hereafter, in the examination of other patents
 “ and of the infringing devices, arrange different details of
 “ mechanical construction, by means of pistons, valves, ports
 “ and springs, which, adopting the supplemental chamber
 “ system first conceived and embodied by the patentee, and
 “ a kindred, but not precisely the same, mechanical method
 “ for the movement of the piston, will accomplish the same
 “ result. The patentee was a pioneer, in that he de-
 “ signed, in No. 376,837, a new way to accomplish a de-
 “ sired result, but upon the same general idea which
 “ he had unsuccessfully tried to work out in the earlier
 “ patent. His later patent was the bridge, and not a
 “ mere step, which carried railroad-car builders from failure
 “ to success. It is not important now to determine the grade
 “ of its pioneership, and whether it may be classed in the list
 “ of those inventions which are of the highest rank ; but it
 “ was an invention created to achieve great necessities and
 “ overcome great hindrances, and was one of wide breadth.
 “ A court would not be justified in adopting ‘a narrow or
 “ ‘astute construction’ which should minimize the character
 “ of the invention, leave its real scope open to trespassers,
 “ and thus ‘be fatal to the grant.’ The claims of the patent
 “ do not contract the grant to narrower limits than those
 “ which the invention as made by the patentee actually cov-
 “ ered, and the claims, therefore, are not limited to the pre-
 “ cise mechanical means described in the specification, by
 “ which the supplementary piston is actuated. They compel
 “ it to be disconnected with and to be independent of a
 “ triple-valve piston, and to be actuated by pressure from an
 “ auxiliary reservoir by some means equivalent to the means
 “ which are described in the specification. The rule which
 “ permits, and indeed compels, courts to give a wide range to
 “ the equivalents which a broad or pioneer patent can include

" is thus expressed in *Miller vs. Manufacturing Co.*, 151 U. S., 186 ; 14 Sup. Ct., 310 : ' If the invention is broad or " primary in its character, the range of equivalents will be " correspondingly broad under the liberal construction which " the courts give to such inventions.' "

When the present case was on hearing at Circuit, his Honor Judge MORRIS found the invention of this Patent 360,070 " paradoxical and startling." Thus he says (66 Fed. Rep., 1000, 1001) :

" Now, although quick-action emergency brakes were being sought for, no one before Westinghouse had accomplished this result, and the means by which he accomplished it were entirely novel. Indeed, upon first impression, it is paradoxical and startling to find that, when a sudden, quick and powerful application of brakes is needed in the face of impending danger, it is to be obtained by a sudden large release of the pressure in the train pipe, to the extent of 15 or 20 pounds below that in the auxiliary reservoir, and that by using this low-pressure air to operate the brake cylinder, instead of the air under greater pressure stored in the auxiliary reservoir, this remarkably effective application of the brakes is obtained. In the domain of quick-action brakes this device would seem to belong to that class of pioneer inventions the patents for which are to be construed so as to be coextensive with the real invention, if the language of the claim will permit it."

And the Court of Appeals for the Fourth Circuit make the same admission in the present case (Opinion, p. 19) :

" That this invention of Westinghouse, thus undefined [the Court then referring to claim 2], is one of the highest value to the public, and that it is a pioneer one in the art of quick-action air brakes is not denied, and is conceded. It is conspicuously one of those pioneer inventions which entitle the proprietor to a liberal protection from the Courts in construing the claim."

These adjudications by two Circuit Courts and two Circuit Courts of Appeal, would seem to establish sufficiently our proposition

that the invention which is now brought to the attention of the Court, is one of no ordinary magnitude and importance. None of greater merit and value, except perhaps the Bell telephone and the incandescent electric lamp, has reached this Court during the present generation; and among those inventions which are for securing the safety of life and property, the Reports disclose none which even approach it in its bearing on public interests.

The First Assignment of Variance and Error.

Claim 2 of Patent 360,070 is the claim which, as is believed, in some respects, best expresses, sums up and covers one of the essential mechanical features and combinations of operative mechanism, which constitute the "pioneer" or basic invention here in question.

The Circuit Court of Appeals for the Fourth Circuit, in the opinion rendered by his Honor Judge HUGHES, says that this claim 2 is invalid, or, to use the exact language employed, that it is "fatally defective."

And this is so held by that Court, not because it is old, nor on account of anything shown in the prior art, but because, by reason of the fact that, omitting, as it did, to specify the particular means or mechanism by or through which the second or "further traverse" of the triple valve piston, opened the emergency valve and admitted air from the train pipe to the brake cylinder, it was to be held invalid, or as stated, because it claimed "only a result." In other words, the claim was held invalid as a matter of law arising on the face of the claim.

The ruling of that Court on that question is thus formulated (Opinion, p. 19):

"We think that when claim 2 of 360,070 in its language describing the action of that device, failed to describe any means by which the extreme traverse of the piston produced it, declaring merely that the piston, 'by a further

"traverse, admits air directly from the main air pipe to the brake cylinder," it was fatally defective, claiming only a result which is public property, and not identifying the specific means (his own property) by which the result is achieved."

This ruling is directly in conflict with a holding of the Circuit Court of Appeals for the *Second Circuit*.

It was there held that this claim 2 of Patent 360,070 was valid, and the action of the Court below in awarding an injunction under this claim was affirmed. And this injunction is still in force in the Second Circuit.

The case at Circuit in which the injunction was granted has already been quoted from (*Westinghouse vs. New York Air Brake Co.*, 65 Fed. Rep., 99). Infringement was alleged *inter alia* of 360,070 and 376,837. Judge LACOMBE granted a preliminary injunction under claims 1, 2 and 4 of 360,070, and claim 1 of 376,837. And it goes without saying that the allowance of an injunction, necessarily presupposes the validity of the claim under which the injunction was granted.

Defendants appealed, and the appeal was heard by Circuit Judges WALLACE and SHIPMAN and District Judge TOWNSEND. A "*Per Curiam*" opinion was filed (69 Fed. Rep., 715), affirming the decree of the Court below as to claims 1, 2 and 4 of Patent No. 360,070, and reversing only as to claim 1 of the other Patent No. 376,837.

This makes a clear case of conflict of decision between the Circuit Courts of Appeals of the Second and Fourth Circuits in the matter of an invention of highest value and importance—that is, the invention of claim 2—not only to the owners of the patent, but equally, or perhaps more so, to the public at large. And hence, it is believed to be a case calling for the intervention of this Court for purposes of review and revision.

And the urgency of the case becomes the stronger in view of the fact stated in the "thirteenth" paragraph (p. 5) of the petition herein,

that there are other causes involving this claim—unheard and undecided—and more particularly one in the Eastern District of Missouri.

If further proof were needed of the high value and importance of this Westinghouse "Quick Action" invention, the extent and character of the litigation thereunder would fully establish it. With approximate correctness the rule may be mathematically stated that the merit and value of a patented invention are directly as the square of the infringements that have taken place under it. Extensive infringement, widespread and vigorously-contested litigation are sometimes the best proof of meritorious invention.

It would seem to be unnecessary to do more than call the attention of the Court to the serious effects which are likely to follow from such a conflict of decisions. A basic claim for a pioneer invention, usable only on railway trains, valid and to be enforced in one Circuit, and at the same time invalid and *not* to be enforced in another Circuit, would, from a commercial and business standpoint, be regarded as simply intolerable. Public interests, independently of private rights, demand that the law as to the rightful use and control of railway train appliances, shall be uniform in all the Circuits, so that a car, whether free of the patent or subject to the patent in any one Circuit, shall sustain exactly the same relationship to that patent in all other Circuits. And, in the present case, there seems to be no way by which this desirable end can be secured except through exercise by this Court of its statutory right of review and revision.

In order not to overlook anything of importance bearing on this question, note should be made of the possible suggestion that this particular ruling of the Court of Appeals in the Fourth Circuit was, in part, at least, the result of the view which that Court took of the prior Westinghouse Patent, No. 220,556. Judge HUGHES does not so state his conclusions, but if he did, the case would remain the same as before. *The New York Court had this same patent before it, No. 220,556.* The Court of Appeals in the Second Circuit did not apparently consider it of enough importance to require discussion,

but as it is specifically mentioned by its number in Judge TOWNSEND's opinion (59 F. R., 586), it was actually in the case and before the Court, and the adjudication in the Second Circuit must be regarded as having been made in view thereof.

Hence there is nothing in this suggestion which can lessen or wipe out the variance or conflict which exists as between the decisions of these two Courts. They are directly at variance not only as matter of law, but also on the same state of facts.

These considerations are believed to sustain fully our first assignment of variance and error.

Second Assignment of Error.

"SECOND. As matter of error herein, your petitioners submit that the said decision of the said Circuit Court of Appeals for the Fourth Circuit, that the said Claim 2 of Patent No. 360,070 is 'fatally defective' in matter of form, or in the substance thereof, is not well founded in fact or in law."

The said claim 2 as printed in the opinion (p. 15) of that Court, and employing the italics which the Court has adopted to indicate the main feature of novelty and infringement, runs as follows :

" 2. In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake cylinder, and a triple valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake cylinder, and *which by a further traverse admits air directly from the main air pipe to the brake cylinder, substantially as set forth.*"

Your petitioners aver and submit that—no other part of the claim being objected to—the portion so in italics is not "fatally defective" either in fact or in law.

The "*means*" are clearly defined, and the claim is not "*unlimited.*"

(1) The second word in italics, "*which*," by its reference to its antecedent "*piston*," defines the *first* "*means*."

(2) "*A further traverse*," motion or movement of that piston is the *second* "*means*."

(3) The *third* "*means*," *a suitable valve*, is as necessarily implied as if it were named. The "*further traverse*," which is the second "*means*," "*admits air directly from the main air pipe to the brake cylinder*."

There is only one "*means*" known in the entire range of the mechanic arts by which to admit air from one receptacle to another, and that means is *a valve*.

(4) The *fourth* "*means*" is "*the main air pipe*."

(5) The *fifth* "*means*" is "*the brake cylinder*."

The fact that the claim omits to specify, and is not, in fact, confined to, the specifically illustrated and described connecting mechanism by and through which the "*further traverse*" of the *piston* opens, the *valve* does not make it "*fatally defective*," nor enable an infringer, who varies those means, to escape the claim.

This has been so recently settled by a unanimous opinion of this Court that a single citation is sufficient.

In *Deering vs. Winona Harvester Works*, 155 U. S., 286, 302, this Court said (p. 302) :

"Defendants further insist that the twentieth claim of this patent is invalid by reason of the fact that, if the board *d* be construed, as it evidently must, as a board pivoted to the butt adjuster, the combination is incomplete and inoperative, because the means by which it is held and controlled are not stated in the claim. * * * Admitting that additional elements are necessary to render the device operative, it does not necessarily follow that the omission of these elements invalidates the claim, or that the precise elements described in the patent as rendering it operative

" must be read into the claim. If Steward were, in fact, the " first to invent the pivotal extension to a butt adjuster, he is " entitled to a patent therefor, though the infringer may " make use of other means than those employed by him to " operate it (*Loom Co. vs. Higgins*, 105 U. S., 580, 584).

" In such case any appropriate means for making it " operative will be understood. Otherwise, the infringer " might take the most important part of a new invention, and, " by changing the method of adapting it to the machine to " which it is an improvement, avoid the charge of infringing " ment."

For these specific reasons for assignments of errors of fact, your petitioners respectfully represent and submit that, in so far as relates to any matter of law, or any question of the form of the claim, it is not true that the said claim 2 claims " only a result."

And for the same reasons and to the same extent, your petitioners submit that the decision of the Circuit Court of Appeals in the Fourth Circuit, as to the invalidity of said claim 2 is manifest error, and that the decision of the Circuit Court of Appeals for the Second Circuit, that the said claim 2 is valid, is manifestly correct.

The discussion of this question and the conclusions reached in the opinion rendered by Judge SHIPMAN in the Court of Appeals, Second Circuit, quoted *supra*, are believed to be conclusive in their cogency.

Westinghouse Air Brake Co. vs. New York Air Brake Co., 63 Fed. Rep., 962, 969.

We are unable even to surmise a reply to our position herein, unless possibly it be this : That what Judge HUGHES meant to say, is that *if* claim 2 of 360,070 be so broadly construed as to cover or include the defendant's apparatus, then it must do so by covering or including the function common to the apparatus of both com-

plainants and defendants, and that a patent which covers a function is void.

If this surmise is correct—and we cannot think of any other—a sufficient answer thereto may be briefly stated :

(1) Whatever Judge HUGHES may have meant, *that* is not what he said. He pronounces claim 2 to be “fatally defective,” and he does so without any conditions or limitations of any kind whatsoever. If he means what he says, and if what he says is not subject to correction in this Court, then it necessarily follows that claim 2 is absolutely void and of no force whatever, within the territorial limits of the Fourth Judicial Circuit. Nor can we *now* see how any Circuit Court in the Fourth Circuit could even listen to an argument to the contrary.

(2) The reason assigned by Judge HUGHES in support of his conclusion that said claim 2 is “fatally defective” is inconsistent with any suggestion that he really meant something else or something less. His language is brief, but clear and expressive beyond any apparent doubt or ambiguity. He says (Opinion, p. 19) :

“ It [claim 2 of 360,070] was fatally defective, claiming only a “result which is public property, and not identifying the specific “means (his own property) by which the result is achieved.”

Thus he seems to say as clearly as words can say it :

FIRST. That the claim is “*fatally defective*.”

SECOND. Because “*claiming only a result*.”

THIRD. He says that this result “*is public property*.”

[What Judge HUGHES meant by saying that this result “is public property” is not clear, for in the next sentence he says that “this invention of Westinghouse * * * is a pioneer one,” etc. If so, then the result was *not* “public property.” But if he means that *all results* are “public property,” then this phrase is to be read as the assignment by him of an additional reason for holding the claim to be void.]

Now, neither of these reasons have anything to do with the prior state of the art, nor with the issue of infringement, nor with the

proofs in the case. It is a bald holding that claim 2 is absolutely void for any purpose whatever, at least in the Fourth Circuit.

And we ask that this holding be reviewed, in this Court :

1st. Because it is directly in conflict with the decision of the Circuit Court of Appeals in the Second Circuit, where this claim was held valid, and where a defendant is now under injunction under it.

2d. Because it is erroneous in its reasonings as well as in its conclusion.

3d. Because such a holding must necessarily introduce serious confusion and conflict in the different Circuits in the administration and application of remedies thereunder ; and

4th. Because it will, unless corrected, work irreparable injury to complainants, as to which latter more will be said presently.

Third Assignment of Error.

The present suit was originally brought in the Circuit Court on December 12th, 1889. *A little over two years later*, under date of August 16th, 1892, Mr. Boyden, one of the defendants, and president of defendant company, procured certain patents under the alleged protection of which the defense was thereafter conducted. Of these Boyden Patents, and of their relation to the case, Judge HUGHES says (Opinion, p. 17) :

“ This question [of infringement] was presented necessarily to the Patent Office of the United States when
 “ Boyden applied for a patent for the device under consideration. That Office employs the best experts in mechanics
 “ which it can secure in this and other countries. Its examinations are indeed *ex parte* in form, but they are nevertheless conducted under hot and skilled contestation in
 “ every case of importance ; and its decisions, though not
 “ conclusive, are entitled to great respect. That Office, after
 “ full examination, awarded a patent to Boyden on the 16th
 “ day of August, 1892, for his quick-action improvement on
 “ the device of Patent 220,556, and that action by the Office

“ was, in effect, a ruling that the Boyden device did not infringe Westinghouse's quick-action Patent Number 360,070. That ruling takes rank here as the testimony of experts of the highest experience, skill and knowledge in mechanics. That ruling was subsequent to the issuing to Westinghouse of both the patents, Numbers 360,070 and 376,837, four years after the latter patent, when the Patent Office had full knowledge of them.”

The above ruling of the Court is excepted to, as well generally as specifically for the following reasons :

(1) It is not true as matter of fact or matter of law, that the Patent Office “ employs the best experts in mechanics which it can secure in this and other countries.”

Under a system of promotion regulated by the rules of our civil service system, ninety-six Examiners are employed at salaries ranging from \$1,400 to \$2,500 per annum.

Whether such low salaries under our civil service system can command the services of “ the best experts,” etc., is too doubtful to constitute properly a part of an adjudication as to valuable rights of property.

(2) The ruling that the examinations made in the Patent Office, though “ *ex parte* in form,” “ are nevertheless,” as stated in the extract above quoted, “ *conducted under hot and skilled contestation in every case of importance,*” is wholly an error. The only contests which can possibly take place in the Patent Office, under any Act of Congress now in force, are in interference cases—and Boyden and Westinghouse were never in interference. All other cases are *ex parte*, the proceedings therein are secret, and as to them no contest can possibly arise.

These errors, though perhaps comparatively small in themselves, lead up to two other errors, both of which are material.

(3) By the grant of a later patent to Boyden it is stated in the extract above quoted, “ that action by the Office was in effect a

"ruling that the Boyden device *did not infringe* Westinghouse's "quick-action patent, number 360,070."

And at that time,—that is, at the time this Patent Office action was taken,—it will be remembered, this case and this question were pending in the Circuit Court.

The question of infringement, under the law, does not belong to the Patent Office, and until the present decision was rendered, it has never been so held.

The ruling or decision thus made, and stated with such freedom from ambiguity, coming as it does from a Court of last resort, is *alarmingly dangerous* to the interests of inventors and patentees everywhere, and is *most dangerous* to those inventions which possess the *highest merit*. What would this Court have said if it had been asked to decide in the Telephone Cases that by the grant of later patents to Dolbear, or to Drawbaugh, or to Edison, or to Gray, and granted while suits for infringement were pending, the Patent Office had made a ruling that the Dolbear, or the Drawbaugh, or the Edison, or the Gray telephone "*did not infringe*" the prior Bell Patent? We mean no disrespect to the Court whose decision we are now calling in question, by saying that, as we understand the law, such a holding is simply revolutionary. If such be the law, then the use of the Patent Office for the purpose of presenting, if not for manufacturing, testimony, to prove an issue upon which the prior patentee cannot be heard on his own behalf, hereby enjoys the highest judicial sanction which it can possibly receive outside of this Court, and in the hands of the infringer, becomes an implement of easy use by which to make in all cases a perfect defense. All he has to do is to apply for and procure at a cost of \$35 a later patent for some further detail of improvement, real or pretended. He can *assert* in his application that his "improvement" or "modification" is not an infringement, etc. As the Patent Office has no jurisdiction of the question of infringement (except, of course, in interference cases, and then only for the purposes of the grant), such assertions in a specification are generally allowed to go unchallenged, and are left for the Courts to pass on. The *claim* is usually scrutinized—

nothing else is (100 U. S., 671, 2). Then, no matter how limited the claim, or how trivial the invention, the later patentee, *by merely getting a patent*, obtains, under the decision now in question, an *ex parte* ruling, not that his device involves merely some patentable additions to, or modifications of, the prior patent, but that it departs so essentially from the *claims* of the prior patent that it does not embody its essential features at all—or, in other words, that it *does not infringe*. By the mere grant of a patent so procured, he would have, under Judge HUGHES' decision, a ruling by the Patent Office of *non-infringement*, which he could properly use as a defense.

Such a defense, so made, has thus been held not merely to raise a *prima facie* presumption that the later patent involves some patentable differences from the prior patent, but that its grant, though not conclusive, is sufficient as a defense, and this ruling has been made by a Court of last resort; and if the error be not corrected, it will work irreparable injury, alarming both in amount and extent, to the most meritorious inventors of our nation—or of the world.

The facts on which this singular decision was made are correctly stated by Judge MORRIS in his decision, and his ruling thereon may properly be quoted here as being substantially correct in its application of the law to those facts. Judge MORRIS (66 F. R., 1006, 1007) says :

“ It is further urged that in a doubtful case the scale
“ should be turned by the fact that, subsequent to the date
“ of the patent in suit, indeed more than two years after the
“ institution of this suit, Patents Nos. 481,134 and 481,135,
“ August 16, 1892, were granted to Boyden for the mechan-
“ ism now used by the defendant.

“ Boyden was entitled to patents for whatever was a
“ patentable novelty in the devices by which he was able to
“ make his valve 22 answer for both service and quick-action
“ work in connection with the restricted passage B, and for
“ any other patentable novelty in the forms of his mechan-
“ ism. The widely different forms in which he has illustrated

“ his devices in the two above-mentioned patents show that,
 “ taking what Westinghouse had discovered and demonstrated
 “ to be the underlying principle of a quick-action brake, a
 “ skillful and inventive mechanic can devise many forms for
 “ applying it.

“ But, in his specification of Patent No. 481,135, Boyden
 “ alleges that his device differs essentially from Westing-
 “ house's Patent No. 360,070, and involves a new mode of
 “ operation. The question whether it does or does not was
 “ the very question then pending in this suit, and, so far as the
 “ Examiner passed upon it, in allowing the specification to
 “ stand, he did so upon the *ex parte* application of Boyden
 “ and unassisted by testimony as to the state of the art at the
 “ date of the Westinghouse Patent, and without testimony as
 “ to the scope of the Westinghouse quick-action invention
 “ and its great importance and merit; and, therefore, with-
 “ out the opportunity of judging whether or not it was a
 “ pioneer invention of a fundamental character, entitled to a
 “ construction co-extensive with the invention, or was simply
 “ a patent for an improvement in a known art, to be restricted
 “ to the form of the device shown in the model and illustra-
 “ tions.

“ The determination of that question is the starting point
 “ in the consideration of the controversy, and, in my judg-
 “ ment, the fact that Westinghouse was the first discoverer
 “ of the vital underlying invention, should turn the scale in
 “ his favor.”

Contrasting with this the ruling made by the appellate tribunal,
 it is respectfully but urgently submitted that an error so gross, and
 in its probable results so fraught with danger to the most meritorious
 inventors known to the law, should not be allowed to pass without
 correction; and this is the only Court where it can be authoritatively
 corrected.

Not only is it true that the Patent Office has no authority to decide or even pass on a question of infringement for the Courts, but it is equally true the Patent Office is not authorized to make or create testimony for the Courts.

While the decision herein complained of does not go to the extent of holding that a Patent Office ruling is *binding* on the courts, and, in fact, says that it is not conclusive, it does give to such ruling an effect which, to say the least, has no foundation in law, and also is highly pernicious. In the sentence next following the clause last quoted, Judge HUGHES says of this Patent Office ruling that it

“takes rank here as the testimony of experts of the highest experience, skill and knowledge in mechanics.”

It would seem to be almost needless to suggest that if a subsequent improver on a pioneer invention can, by the mere *ex parte* act of procuring a subsequent patent, after being sued, *make or create* “testimony” for himself—and testimony which may “take rank” in a Federal Court as that “*of experts of the highest experience, skill and knowledge in mechanics*,” then one of the great safeguards erected for the protection of patented property is entirely destroyed. *On mechanical questions the law knows no higher testimony than that which is thus defined; and hence, when such testimony is furnished, it cannot successfully be rebutted.*

And if this be a correct statement of the law, then, in patent cases, under the issue of infringement, the Courts will have little to do (except in cases of *manifest* error) but to register and enforce the *ex parte* rulings of the Patent Office.

Miller vs. Eagle Manufacturing Co., 151 U. S., 186, stated the rule that the grant of the later patent merely raised “a *prima facie* presumption” of the existence of a “patentable difference” in the latter patent (p. 208), but in other branches of the case this Court distinctly declined to follow and apply a ruling of the Patent Office as to the existence of patentable difference between two patents issued by the Patent Office (p. 202). The

decision of the Circuit Court of Appeals of the Fourth Circuit goes far beyond any decision of this Court in attributing weight and value to the *ex parte* rulings of the Patent Office.

The decisions heretofore made by this Court are believed to be in strict accord with the views we are seeking to present.

The question arose in *Blanchard vs. Putnam*, 8 Wall., 420. Mr. Justice CLIFFORD, in rendering the opinion of the Court (p. 426), said :

“ Attempts are often made in the trial of patent cases to introduce such collateral issues on the question of infringement, but they are irregular and cannot be sanctioned, as the only proper comparison, on that issue, is of the defendant's machine with that of the plaintiff, as prescribed in the pleadings. What the jury have to determine is, does the machine of the defendant infringe the machine of the plaintiff ; and if it does not, then the defendant is entitled to a verdict ; but if it does infringe the plaintiff's machine, then the plaintiff is entitled to his remedy, and it is no answer to the cause of action to plead or prove that the defendant is the licensee of the owner of another patent, and that his machine is constructed in accordance with that patent.

“ Controversies between litigants in court cannot be completed in that way, nor should the plaintiff be subjected to such outside issues, as he is clearly entitled to a verdict when he has proved that he is the original and first inventor of his improvement, and that the defendant has infringed his patent.”

The present case comes exactly within the rule thus stated in these essential features :

- (1) A pioneer patent to complainant.
- (2) A structure or device made by defendant.
- (3) An issue of infringement raised thereby.
- (4) A later patent under which defendant claims to be working.
- (5) A case for final disposition, not for a preliminary injunction.

Under these facts and conditions, *Blanchard vs. Putnam* says

that the patent under which defendant claims to be working is not admissible in evidence at all *under the issue of infringement*.

Later cases which *look like* modifications of this rule relate, for the most part, if not entirely, either to some side or collateral issue, or else are exceptional in their nature.

In *Boyd vs. Tool Co.*, 158 U. S., 260, neither party was a pioneer, and both applications were pending at the same time—a very different case.

In *Pavement Co. vs. City of Elizabeth*, 4 Fish., 189, cited in *Boyd vs. Tool Co.*, the question arose on a motion for a preliminary injunction. In such proceedings presumptions count as evidence, and hence a patent to defendant is worth something in support of a presumption.

But on final hearing, or in what is practically the final disposition of a case, mere presumptions do not count for much. And even in *Miller vs. Eagle Co.* it was merely referred to as a confirmatory consideration, and then only as of a *prima facie* character.

In *Wollensack vs. Reiher*, 115 U. S., 96, the effect to be given to a Patent Office decision arose under a question of reissue. More than two years had elapsed between the date of the original patent and the date of the reissue. Proofs satisfactory to the Commissioner of Patents had been submitted to the Patent Office, so as to account for the delay, and the Commissioner, being satisfied with those proofs, had granted the reissue. These facts were set up in the bill. Defendant demurred, and the Supreme Court, in sustaining the demurrer, after reciting the facts as above stated—that is, the decisions which had been made on the proofs so submitted—added the following (p. 101):

“But this does not satisfy the law. The question as to whether the delay had been reasonable or unreasonable is for the courts to determine, upon the special circumstances brought to its attention, and it cannot substitute the decision of the Patent Office upon that question for its own.”

Hence, it is believed that the law of *Blanchard vs. Putnam* is still the law of the land. And even if later decisions have

tended to modify it, it has never been modified as applicable in a suit on a pioneer patent, and still further has never been so far modified that a grant of a patent becomes testimony of high rank as establishing non-infringement in a Federal Court, and still more so when the later patent is not procured until more than two years after suit is brought.

It is submitted that the effort to raise *ex parte* departmental decisions practically to the rank of adjudications which are authoritative as "testimony" in Federal Courts of last resort, embodies so great and dangerous an error as to create an unusually urgent call for the intervention of this Court by the exercise of its statutory powers of review.

Fourth Assignment of Variance and Error.

This relates to the force and meaning of the phrase "substantially as set forth," which is appended to claim 2 of 360,070. The ruling therein of the Circuit Court of Appeals for the Fourth Circuit is believed to be directly at variance with the decisions of this Court, and to be in error as matter of law.

The ruling thus assigned for variance and error is formulated or stated by Judge HUGHES as follows (Opinion, pp. 15, 16) :

" The phrase ' substantially as set forth ' is technical, and
 " is equivalent to saying ' by the means described in the text
 " ' of the inventor's application for letters patent, as illustrated
 " ' by the drawings, diagrams and models which accompany
 " ' the application.' These words limit the general terms
 " of the specification which set out the *function* performed
 " by the invention, and confine the inventor's rights to his
 " own *means*, or their mechanical equivalent of performing
 " the function."

It is submitted that in this extract are contained two statements of law, both of which are at variance with the rulings and decisions of this Court.

1. In holding that "substantially as described" is a limiting phrase, not as to the *general combination* of mechanism recited in the claim, but as to elements of mechanism *not* recited in the claim, and which may be varied from without departing from the main invention.

In *Lake Shore & M. S. Co. vs. National Car Brake Shoe Co.*, 110 U. S., 229, 235, this identical question arose, and, under one of the claims in suit, was the main point in controversy. The question is discussed at length (p. 235). We quote three lines, the italics being our own :

"The words 'substantially as specified' mean substantially as specified in regard to *the combination which is the subject of the claim.*"

In *Deering vs. Winona Harvester Works*, 155 U. S., 286, 302, the twentieth claim of the patent in suit was in the following words (p. 290) :

"20. The combination in a grain binder, of moving butt-adjusting mechanism, and the board *d*¹, *substantially as described.*"

The defendants insisted (p. 302) that this 20th claim was invalid because the *means* by which the board *d*¹ was held and controlled in its pivotal connection to the butt-adjuster were "not stated in the claim," or that certain additional elements by which it was described as so held and controlled, must be "read into" the claim, but this Court (as already quoted) decided otherwise, saying (p. 302) :

"Admitting that additional elements are necessary to render the device operative, it does not necessarily follow that the omission of these elements invalidates the claim, or that the precise elements described in the patent as rendering it operative *must* be read into the claim. If Steward were in fact the first to invent the pivotal extension to a butt-adjuster, he is entitled to a patent therefor, though the infringer may make use of other means than those employed by him to operate it (*Loom Co. vs. Higgins*, 105 U.

“ S., 580, 584). In such case any appropriate means for making it operative would be understood. Otherwise, the infringer might take the most important part of a new invention, and, by changing the method of adapting it to the machine to which it is an improvement, avoid the charge of infringement. The invention of a needle with the eye near the point is the basis of all the sewing machines used ; but the methods of operating such a needle are many, and if Howe had been obliged to make his own method a part of every claim in which his needle was an element, his patent would have been practically worthless.”

The decision of Judge HUGHES is directly at variance with this in that it applies this phrase “substantially as described,” to the particular “means” which are merely *supplementary* to the elements of the claim (meaning a particular valve and particular passage way to it, illustrated by Westinghouse), instead of, as it should do, to *the combination* of those elements which are actually recited in the claim.

The same rule of construction is practically embodied in the following extract from the old (1853) case of *Winans vs. Denmead*, 15 How., 330, 342 :

“ It is generally true, when a patentee describes a machine, and then claims it as described, that he is understood to intend to claim, and does by law actually cover, not only the precise forms he had described, but all other forms which embody his invention ; it being a familiar rule that, to copy the principle or mode of operation described is an infringement, although such copy should be totally unlike the original in form or proportions.”

Such has always been the uniform rule in the Federal Courts, especially when dealing with “pioneer” inventions. It is hardly conceivable that the door is now open for the establishment of a different and less favorable rule.

(2) The other variance, or rather error, double in its character, arose from the failure on the part of the Court of Appeals in the

Fourth Circuit to note two important limitations in applying the rule as to "means" and "mechanical equivalents."

(a) As to "means," the inquiry was not limited, as it should have been, to the means which are *essential and substantial to the invention*. This was clearly an error.

(b) As to "mechanical equivalents," the liberal rules of construction repeatedly announced from this Bench as applicable to pioneer inventions, were either overlooked or ignored. Such rulings are too numerous for quotation, but reference may be made to the following leading cases :

Morley Machine Co. vs. Lancaster, 129 U. S., 263, 273.

Clough vs. Barker, 106 U. S., 166, 177.

Consolidated Valve Co. vs. Crosby Valve Co., 113 U. S., 157.

McCormick vs. Talcott, 20 How., 402, 405.

Deering vs. Winona Co., 155 U. S., 206, 302.

Miller vs. Eagle Mfg. Co., 151 U. S., 186, 207.

And for a convenient summing up of the law herein, and for a proper application of such law to a collateral branch of this case, we respectfully refer the Court to the extract, *supra*, pp. 4-6, from the decision in the Court of Appeals in the *Second* Circuit (63 F. R., 969). What is there said under Patent 376,837, is *mutatis mutandis*, applicable in still higher degree under the earlier Patent 360,070.

The correction of these errors is material to the rights of the petitioners herein.

This will amply appear on a brief statement of a few facts.

(1) The Westinghouse Patent No. 360,070, here in suit, is a pioneer patent, or the first of its kind, and is so both confessedly and by all the adjudications yet made thereunder.

(2) Claim 2 of this patent, held valid in one Circuit and invalid in another Circuit, is a claim which is most broad and comprehensive in its terms, and, if valid, will give efficient and ample protection to the actual invention stated therein. If held to be

invalid, so much of the invention as is within its scope, and outside the scope of the remaining claims, will cease to have any protection whatever.

Believing the decision in the Fourth Circuit as to the invalidity of this claim to be in error, and as well at variance with the decision in the Second Circuit, and believing that thereby a valuable and material portion of the Westinghouse "Quick Action" invention is liable to fail in receiving proper and lawful protection, it is submitted, not only that the variance and error are material, but that they are *so* material as to be entitled to corrective relief in this Court.

(3) The adverse rulings made in the opinion of Judge HUGHES as to the effect of the issue of later patents to Boyden, and as to Patent Office rulings generally, bearing directly *on the issue of infringement*, and being so stated by the Court, cannot be otherwise than highly material to the rights of the petitioners herein.

(4) And the same is true as to the limitations imposed on said claim 2, under the phrase "substantially as set forth." But for these limitations the issue of the infringement must have been found in favor of complainants below—the petitioners here. And this will appear from a comparison of defendant's device with the terms of the claim, as well as from Judge MORRIS' opinion rendered in the Court below (66 F. R., 997).

Hence it is submitted that the correction of *these* errors, and without regard to other material errors yet to be noted, will probably, if not necessarily, result in a finding in this Court in favor of the petitioners herein, and a reversal on all the claims of the decision now sought to be reviewed.

Irreparable Injury.

Proper averment of "irreparable injury" to petitioners is made in the "fifteenth" paragraph of statement in the petition for the writ (Petition, pp. 5, 6).

It would seem to go without saying that a case of "irreparable injury" of most serious character was presented, when a Court of last resort (erroneously as is alleged) holds to the invalidity of the claim which, in its terms, appears to afford the best protection to the invention as made, and especially when such holding is in direct conflict with a decision of the same question in another Court, also of last resort, in another circuit.

Still more so when such erroneous decision limits the claim unduly, by reliance on *ex parte* "testimony," created for the purpose, by the procurement of a patent by defendant after the suit was brought.

And still more so, when the decisions of this Court are overlooked or disregarded in imposing, under "substantially as set forth," improper and unauthorized limitations on the claim.

And these considerations acquire still greater cogency in view of the fact that over four hundred thousand cars, passenger and freight, have been equipped in this country with quick action brake apparatus under (as was supposed) the protection, inter alia, of this claim 2 of Patent 360,070. Fully an equal or perhaps a still greater number yet remains to be equipped. And under Act of Congress, such further equipment must be completed by or before January 1st, 1898.

These suggestions apply more or less perfectly under remaining assignments of error, but we insert them here merely as a matter of convenience.

Fifth Assignment of Error.

FIFTH. As further matter of error herein, and as a matter irreconcilably at variance with the ruling of the Circuit Court of Appeals in the First Circuit, your petitioners further submit that manifest error was made by the said Circuit Court of

Appeals for the Fourth Circuit, in holding as matter of law that the mere erasure from the specification as originally filed, of a description of a proposed modification, operates as a disclaimer of such modification.

In the Westinghouse specification as originally filed, a *non-integral* emergency valve was described, and a clause was added to the effect that "the same office is performed by a valve *integral* with the main valve," etc.

The Patent Office, under its rules of practice, required this clause to be erased, for the reason that such an *integral* structure was not illustrated in the drawings. Whether, as a mechanical equivalent, it would come within the terms of the claims as allowed, was a question with which the Patent Office had no concern. The decision of that question belonged to the Courts. The clause in question was erased. Judge HUGHES' opinion, as understood, holds that an *erasure* in law amounts to a *disclaimer*.

This question arose directly in the Court of Appeals, in the Second Circuit, and it was held otherwise.

Reece Button-Hole Machine Co. vs. Globe Button-Hole Machine Co., 21 U. S. App., 244; 10 C. C. A., 194; 61 Fed. Rep., 958.

This Reece case contains probably the fullest discussion this question has ever received. Supreme Court cases are cited in large number and applied or distinguished. The conclusions reached by the Court in the Reece case, seem to be well founded in law, but the discussion is too lengthy for quotation in full. In 61 Fed. Rep., 967-970, will be found the portion of that decision here in point. The reasons there presented are so persuasive that we feel safe in submitting this part of our case thereon.

The remaining assignments of error do not probably contain any matters more imperatively requiring review and correction than those above presented.

Hence we deem it unnecessary to weary the Court with a discussion of them in detail ; and the more so, because of the complicated character of the apparatus in which the invention is embodied, and because of the contradictory character of the testimony. In fact there are, we believe, only two important facts in the case, as to which there is no dispute.

FIRST. The merits and high rank of the Westinghouse invention as a pioneer in this branch of the arts, are not denied.

SECOND. There is no dispute as to the form or construction of defendant's apparatus.

Everything else is denied. The method of operation involved in the orderly movement of the piston and valves of defendant's apparatus, and the relationship of that apparatus to complainant's patent, and to sundry prior patents, are among the chief questions in dispute. And these questions involve sundry matters of fact which cannot be made clear except by oral presentation, or in lieu thereof, by a written treatise on air brakes of such length and fullness that no court can reasonably be asked to read it.

For these reasons, our right to a writ of *certiorari* herein is' submitted on the first five assignments of error. When the cases come up for oral argument, if the Court should so order, we will ask to be heard, if need be, on the matters referred to in the other assignments of error.

FREDERIC H. BETTS,
 GEORGE H. CHRISTY,
 For Petitioners.

GEORGE H. CHRISTY,
 Solicitor.
 FREDERIC H. BETTS,
 J. SNOWDEN BELL,
 BERNARD CARTER & SONS,
 Of Counsel.

In the Supreme Court of the United States.

IN THE MATTER OF THE PETITION

OF

GEORGE WESTINGHOUSE, JR., and THE WEST-
INGHOUSE AIR BRAKE COMPANY for a Writ of
Certiorari.

Reply to the Brief for the Boyden Brake Company.

His Honor the Chief-Justice was understood to say to counsel, at the time the motion was submitted, that, if the Boyden brief presented anything new, a reply thereto could be made.

The brief, as submitted, is believed to contain one or two matters of this kind.

1. It is contended in the Boyden brief that the suit is not one of peculiar gravity and general importance, for the reason that the *invention* of Patent No. 360,070 is not of *such* importance as the petitioners allege.

In support of this the Boyden brief asserts, in substance, that the invention of the patent in suit, No. 360,070, is not in use, either upon 400,000 freight cars or otherwise, "and has not been made since 1887." Brief, page 8, is thoroughly misleading, as are also the quotations from page 224 of the record.

What was asked of Mr. Westinghouse in those questions was whether the Westinghouse Company's catalogue for 1890 contained illustrations of their quick-action brake "like that shown in the

"drawings of the Letters Patent No. 360,070," or whether the company were *now* making or selling brakes of the type or form "shown in the drawings" of said patent.

This testimony is distorted from its actual meaning, which was, merely, that the Westinghouse Company were not now making *the particular form* of the invention shown in the drawings, into a statement that they were not utilizing *the invention itself*, which, being of a primary character, was capable of embodiment and expression in a number of forms.

The record abundantly shows that the Westinghouse Company are now manufacturing, and have been manufacturing since 1887, brakes which embody the invention of their Patent No. 360,070, and are based upon that invention, although, as in the case of all progressive manufactures, the form in which the invention is embodied has undergone development and change, and has been modified by the introduction of supplementary improvements, of which that of Patent No. 376,837 is of great importance.

This state of facts clearly appears by the decisions of the Courts to which reference has been made, and an attempt to make it appear otherwise in the brief of the Boyden Brake Company is hardly fair.

The statements contained in our original petition are strictly correct.

2. Again, in order to explain away the conflict of opinion between the appellate Courts in the two circuits, as to the validity of the second claim of 360,070, the Boyden brief relies on the differences between the alleged infringing structures.

This has to do with the issue of infringement—not with the issue of the validity of the patent.

While there were important differences of structure between the infringements complained of in the two cases, yet the Circuit Court of Appeals for the Fourth Circuit went far beyond the point of merely deciding upon these differences. It is true that it adverted to the difference between the two structures in the two concluding clauses of its opinion as a reason why it did not regard the opinion

of the Circuit Court of Appeals for the Second Circuit as controlling upon it, but it went much further than this, and expressly held, in the passages cited in our petition and in the accompanying brief, that the second claim was invalid, or, as stated, "fatally defective," because functional in character, and because it omitted necessary elements to make its combination complete.

The claim, on its face, clearly, in terms, covered the defendant's structure in the case in the Fourth Circuit. The Court got rid of its effect by holding that it was "fatally defective."

This was the real gist of the decision, and the basis of the opinion of the Court.

The reference to the difference of the structure before it and that before the Court for the Second Circuit was merely cited as a reason for not following the decision of that Court upon a point which they had already decided upon other grounds, which other grounds involve, as we submit, a clear conflict of opinion between the two Circuit Courts of Appeal.

In a case of the importance of the present one, where the invention is in use, and largely in use, in every circuit of the United States (as is shown in our petition and principal brief), it is essential that decisions so palpably in opposition to each other upon a fundamental point should be subject to the review of this Court. Other suits are pending in still other circuits (as shown by our petition) against still other forms of apparatus, and the validity of the second claim of the Westinghouse Patent No. 360,070 is a fundamental question in those suits, preliminary to the consideration of any question of infringement whatever.

That question can only be settled for the whole country by this Court.

This probably brings us to the limit of the permission granted us to reply. But it is believed that the other points of the Boyden brief, or most of them, are sufficiently discussed in our original brief.

GEORGE H. CHRISTY,

For Petitioners.

105. 049 a 878.

MAR 26 1896

JAMES H. McKENNEY,
CLERK

Supreme Court of the United States.

Brief of Christy & Betts for Westing

OCTOBER TERM, 1895. Nos. 847 and 878.

House Co. (on mo.)

Filed Mar. 26, 1896.

BOYDEN POWER BRAKE COMPANY, GEORGE A.
BOYDEN, President, CHARLES B. MANN, Secretary,
WILLIAM WHITRIDGE, Treasurer, and BOYDEN
BRAKE COMPANY,

Appellants,

vs.

Appeal.

GEORGE WESTINGHOUSE, Jr., and THE WESTING-
HOUSE AIR BRAKE COMPANY,

Appellees.

GEORGE WESTINGHOUSE, Jr., and THE WESTING-
HOUSE AIR BRAKE COMPANY,

Appellants,

vs.

BOYDEN POWER BRAKE COMPANY, GEORGE A.
BOYDEN, President, CHARLES B. MANN, Secretary,
WILLIAM WHITRIDGE, Treasurer, and BOYDEN
BRAKE COMPANY,

Appellees.

Cross-Appeal.

Answer of Westinghouse Air Brake Company
and George Westinghouse, Jr., to the Petition
of Boyden Power Brake Company et al.

GEORGE H. CHRISTY,
FREDERIC H. BETTS,
Counsel for Westinghouse Air Brake Company et al.



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Supreme Court of the United States.

OCTOBER TERM, 1895.

BOYDEN POWER BRAKE COMPANY,
GEORGE A. BOYDEN, President;
CHARLES B. MANN, Secretary;
WILLIAM WHITRIDGE, Treasurer,
and BOYDEN BRAKE COMPANY,
Appellants,

vs.

GEORGE WESTINGHOUSE, JR., and
THE WESTINGHOUSE AIR BRAKE
Co.,

Appellees.

No. 847.
Appeal.

GEORGE WESTINGHOUSE, JR., and
THE WESTINGHOUSE AIR BRAKE
Co.,

Appellants,

vs.

BOYDEN POWER BRAKE COMPANY,
GEORGE A. BOYDEN, President;
CHARLES B. MANN, Secretary;
WILLIAM WHITRIDGE, Treasurer,
and BOYDEN BRAKE COMPANY,
Appellees.

No. 878.
Cross-Appeal.

ANSWER

of the Westinghouse Air Brake Company and George Westinghouse, Jr. (complainants at Circuit), to the petition of Boyden Power Brake Company et al. (defendants at Circuit).

In answer to the petition filed by the Boyden Brake Company *in re* motion to advance the hearing of the above-entitled causes, the Westinghouse Air Brake Company and Geo. Westinghouse, Jr., through their counsel, submit the following as their reply :

They have no objection to an early argument of the cases. But they do not understand that under Rule 26 they have any right to an advance, and, hence, they have not formally united in the application. It is a case between private parties solely. It is not a *criminal* case, nor a *revenue* case, nor a case in which the United States is concerned. But if, in the opinion of the Court, the cases involve or affect some matter of such general public interest that they ought to take precedence of other cases which have been still longer pending between private parties, then these repliants have no objection to their being advanced so as to be heard at some convenient time during the next ensuing term of the Court.

It would be practically impossible to get the record printed and proper briefs prepared under the rules before the probable end of the present term. The record contains over 1,400 pages of matter in book form, and includes a large number of drawings which would have to be reproduced by photo-lithography.

The general facts recited in the petition are stated purely from the Boyden standpoint, and for the most part, where material, are erroneous or misleading. These errors and misleading statements made are too numerous to be reviewed in a short reply.

Fact and fallacy are so dexterously intertwined in the petition that to separate them would unduly lengthen this reply.

Briefly summarized, the reasons alleged in support of the petition are as follows :

1st. The questions involved are of "*great public importance.*"

2d. The case involves only *one* question, *that of infringement*, and hence can be readily disposed of by the Court with "*no unusual amount of labor.*"

3d. The Boyden Co., partly as the result of an injunction and partly as the result of competition, has been kept out of a highly lucrative business for six years.

4th. Under Act of Congress of March 3d, 1896, Chapter 196, the business for which the Boyden Co. was organized will all be done by or before January 1st, 1898, and hence it should be allowed an early chance at the business.

5th. The defendant company has a patent, and in consequence of this litigation has been deprived of nearly four years' enjoyment of the seventeen years' privilege thus accorded to it, and it would be grossly unjust if such deprivation be continued for one or two years longer.

It is believed that every fact or alleged fact contained in the twelve pages of the printed petition comes under one or another of these five heads.

We will consider them separately :

1st. That the questions involved are of "*great public importance.*"

Several questions are involved which *vary* in importance.

(1) The question of *infringement*—that is, does the Boyden

device infringe the Westinghouse Patent—is (outside of the parties) of considerable importance to railway and transportation companies, but only indirectly so to the public at large.

(2) The Court of Appeals in the Fourth Circuit held that claim 2 of the patent in suit was “fatally defective.”

The Court of Appeals in the First Circuit, in another case, held that this claim 2 was valid.

Both actions of the Court are still in force, each in its own jurisdiction.

The claim as to which these contradictory decisions were made is the claim which, as is believed, in some respects best expresses, sums up and covers one of the essential mechanical features and combinations of operative mechanism which constitutes the “pioneer” or basic invention here in question.

This is *the* question which is raised under our first assignment of error. It is a question which (outside of the parties) is of considerable importance to railway and transportation companies, but only indirectly so to the public at large.

(3) The question raised by our second assignment of error as to the validity of the claim last referred to, as matter of law, has the same extent and limitations of public interest.

(4) The next assignment of error involves a question which is of general importance to all inventors, patentees and to all owners of patent property, and hence is of general *public* importance, in so far as *they* constitute or represent *the public*.

After the suit was brought the Boyden Company procured, in Boyden's name, a patent in which it was stated, in effect, that the Boyden invention was *substantially different* from that of Westinghouse. The proceedings under the Boyden application were wholly *ex parte*, Westinghouse being in no way heard or represented, or even notified.

The Court of Appeals in the Fourth Circuit, in the opinion which was filed, inadvertently fell into numerous errors as to matters of fact connected with Patent Office practice, but also made still more serious errors of law in holding that this action

of the Patent Office was "in effect a ruling that the Boyden "device did not infringe Westinghouse quick-action patent "number 360,070," that being the patent in suit, and, still further, was equally erroneous in its law when it said that "that "ruling takes rank here as the testimony of experts of the "highest experience, skill and knowledge in mechanics."

This is, we believe, the only question pending in this case which is of any *greater* importance to the *public* outside of railway and transportation companies than the questions which ordinarily arise in patent cases.

(5) The fourth and fifth assignments of error—the fourth as to the meaning of "substantially as described," and the fifth as to the effect of a mere erasure from a specification—are also of importance to inventors and patentees, but not more so to the public at large than is usual in patent causes, when similar questions arise.

Of course, all these questions are of exceedingly *great importance* to the parties themselves.

2d. The next point of the petition, as we have summarized it, is that this case involves only *one* question, that of *infringement*, and, hence, can be readily disposed of by the Court with "*no unusual amount of labor.*"

Thus, at the top of page 12, of the petition, it is said :

"No question of prior invention, anticipation or public use "is raised, but simply the question of infringement."

Our reply is :

(1) It does not require a record of 1,400 book pages to present simply *one* question of infringement.

(2) The conflicting opinions of two Circuit Courts of Appeals are to be dealt with.

(3) The validity of the second claim of the patent in suit, held valid in the Second Circuit, and invalid in the Fourth, is to be dealt with.

(4) The effort to make it appear that in the Circuit Court of Appeals for the Fourth Circuit, the invalidity of the second claim of the patent in suit was only *conditional* invalidity—that is, that the Court did not mean what it said—is not borne out by the record.

In the first place, the Boyden Company, in their answer, Record, page 9, paragraph 7, distinctly and unqualifiedly averred (referring to the patent sued on), that “the second claim is invalid, and should not have been granted.” Hence, by their own act, they made *this* one of the issues in the case.

In the next place, in the brief of the Boyden counsel in the Court of Appeals, a special section was headed with the following title :

“THE SECOND CLAIM IS VOID AS BEING FOR A FUNCTION AND NOT FOR A MECHANISM.”

Four pages of the brief (pp. 42-45), were exclusively devoted to maintaining the proposition stated in this heading, and no less than fifteen citations were made.

In the oral argument in the Court of Appeals (stenographically reported) one of the counsel for the Boyden Company introduced this part of his argument with the following words :

“Now, in the brief, and my time is so limited that I shall not take up the time to argue it orally, I ask your Honors to look at pages 42 to 45 of our main brief, which argues fully the question of the second claim being for a function and not a mechanism, and, therefore, void under the ruling in *O'Reilly vs. Morse*.”

This also is a question in the case, outside of infringement. For it is conceded on all hands that if the claim be construed as it reads, infringement cannot be denied. And this is the reason why the Boyden Co. elected to make an issue of the validity of this claim.

(5) And still further, the attack on the validity of this claim is the cause of the larger part of the 1,400 book pages of record. The Boyden Co. set up in defense and offered in evidence a large number of prior patents, English and American, and experted them through hundreds of pages, and made and presented in evidence experimental constructions of some of them, in order, if possible, to detract from the merits of the invention in controversy, and to show that Westinghouse, under the patent in question, was not entitled to the benefits of the doctrine of pioneership which had been so overwhelmingly granted to him by the Court of Appeals in the Second Circuit.

Hence, the position of Westinghouse as a pioneer in the art is one which, under the proofs, will necessarily involve here, as in every case thus far argued, an amount of labor on the part of the Court much in excess of that which is usual in patent cases.

(6) The petition fairly bristles with statements which involve issues here in controversy.

Thus, the statement of the nature of the Westinghouse invention here in question, as found in the middle of page 3, is wholly misleading. In fact, the scope of the invention is one of the chief issues of the case.

So, in the first paragraph of page 4, the question as to whether Mr. Boyden "invented another and radically different" means for accomplishing the same result is one of the contested issues in the cause. What is there said on this subject is merely a statement of the Boyden position, while, according to the Westinghouse contention, the reverse is the case.

Several other misleading statements of like kind could easily be pointed out, if time and space permitted.

(7) The argument before Judge MORRIS at Circuit occupied four days. In the Court of Appeals two days were allowed, and the second day was extended beyond the usual hour for

adjournment. Both Courts found that "an unusual amount of labor" was involved.

Printed briefs and arguments submitted to the Court of Appeals when added up amount to *four hundred and thirty-six pages*. And all for what, in the Boyden Petitions, is alleged to be "simply the question of infringement!"

(8) The Boyden appeal includes *eighteen* assignments of error (Rec., pp. 1379-1381), which was certainly rather a large number on which to take up to the Court of Appeals "simply the question of infringement."

And the Westinghouse case went up to the Court of Appeals on *seven* assignments of error, and comes into this Court with *twelve more*.

Hence, it is believed that the petition somewhat understates the facts when it says that "simply the question of infringement" is involved, and that the cases will involve "no unusual amount of labor."

3d. The next point of our summary of the Boyden petition is that the Boyden Company, partly as a result of an injunction, and partly as a result of competition, has been kept out of a highly lucrative business now for six years.

Our reply is :

(1) If it is lucrative, the Westinghouse Company has made it so, and that is why it has had to raise and invest \$5,000,000 of capital, so as to be able to supply the demand which it has created.

(2) The railway companies are not complaining of excessive charges for brake apparatus.

(3) In so far as by lawful and proper competition, the Boyden Company may have been kept out of business for the past six years, the petition states no groundwork for the special interference of this Court.

(4) It is not true as represented on page 5 of the Boyden petition, that the Boyden Company and its co-petitioners were

ever under injunction. While an injunction was allowed, none was ever issued. If the petitioners ever discontinued business, they did it either voluntarily, or else because they made a brake apparatus which nobody would buy.

(5) And as the petition has traveled largely outside the record, we may be permitted also to go outside so far as to say that with the growth of the art, the Boyden device involved in this case has so far ceased to be in demand that the manufacture thereof was discontinued long ago, and the Boyden Co. is now seeking to introduce and sell a device *differing in material respects* from the one here in controversy. Hence, the question of infringement *as thus raised* is no longer a question of importance even *to the Boyden Company*—though it is to us—involving, as it does, the scope and validity of our patent.

4th. The fourth clause of our summary of the petition is to the effect that under Act of Congress, Chapter 196, the air brake business must all be done by or before January 1st, 1898.

(1) The Act of Congress referred to on page 6 of the petition (Act of March 3, 1893, Section 1 of Chapter 196) does not require, as cited in the petition, that “all railroads engaged in interstate commerce must be fully equipped with power brakes on or before the 1st day of January, 1898, or suffer a heavy penalty.” The section referred to reads as follows, and we italicise seven words:

“That from and after the first day of January, 1898, it shall be unlawful for any common carrier engaged in interstate commerce by railroad to use on its line any locomotive engine in moving intersate traffic not equipped with a power-driving wheel-brake and appliances for operating the train-brake system, or to run any train in such traffic after said date that has not *a sufficient number* of cars in it so equipped with power or train brakes that the engineer on the locomotive

drawing such train *can control its speed* without requiring brakemen to use the common hand-brake for that purpose."

Hence, all the act requires is that within the next two years *enough* cars must be equipped with power brakes so the train can be *controlled by the engineer*, which is a very different thing from saying that *all* must be so equipped.

Hence, in the orderly course of events, these cases will be reached and disposed of long before *all* the freight cars of the country will have been equipped with power brakes.

(2) Whether the Westinghouse Company can furnish air-brake equipment within the next two years for all freight cars which now are not equipped is a matter wholly outside the record, but we are authorized to say that the Westinghouse Company can supply such equipment to all the railways of the United States as rapidly as, with their present shop facilities, the railway companies can put them on. Hence, the railway companies will not suffer if these cases stand till reached on regular call.

(3) The air brake business will not end January 1st, 1898, as the petition seems to apprehend. In round numbers, there are about forty to fifty thousand new cars built in this country every year, and the number is more likely to increase than diminish. After this case is reached and disposed of on the regular call of the docket, if the result be favorable to the Boyden Co., it will find plenty of business still to be done.

5th. The Boyden Company also says that it has a patent, and in consequence of this litigation, has been deprived of nearly four years' enjoyment of it, and that it would be unjust if such deprivation be continued for one or two years longer.

This is wholly fallacious.

The taking of a patent does not grant to the patentee any right to make, use and sell, *which did not belong to him before the patent was granted*. The patent merely grants to the pat-

entee the right *to forbid others* from making, using or selling the thing patented. *This right of prohibition* granted to Boyden by his patent, he and his company have fully enjoyed ever since the date of the patent, and they are enjoying it yet. Hence, in this regard, the Boyden Company is not suffering any hardship of which they have any right to complain in this Court.

Respectfully submitted,

GEORGE H. CHRISTY,

FREDERIC H. BETTS,

Counsel for the Westinghouse Air Brake Co., &c.

Supreme Court of the United States.

OCTOBER TERM, 1896.

No. 403.

BOYDEN POWER BRAKE CO. ET AL.,
DEFENDANTS AND APPELLANTS,

VS.

GEORGE WESTINGHOUSE, JR., and THE WESTINGHOUSE
AIR BRAKE COMPANY,
COMPLAINANTS AND APPELLEES.

No. 426.

GEORGE WESTINGHOUSE, JR., and THE WESTINGHOUSE
AIR BRAKE COMPANY,
COMPLAINANTS AND APPELLANTS,

VS.

BOYDEN POWER BRAKE CO. ET AL.,
DEFENDANTS AND APPELLEES.

BRIEF FOR WESTINGHOUSE.

Suit was brought in the U. S. Circuit Court for the District of Maryland by Westinghouse and The Westinghouse Air Brake Company, by bill in equity in the usual form, for infringement of the Westinghouse Patent No. 360,070, claims 1, 2 and 4.

Decision by MORRIS, J., was in favor of complainants under claim 2, that the claim was valid and was infringed, but adverse under the other two claims, the Court finding non-infringement as to these claims (Opinion, Rec., p. 842).

Each party appealed from so much of the decree as was adverse.

The decision of the Court of Appeals for the Fourth Circuit was adverse to complainants on all points, holding that the first and fourth claims of the Patent in suit were not infringed, and that the *second* claim was "fatally defective" (Rec., pp. 869-883). This opinion, as to the second claim, was in conflict with the decision of the Court of Appeals in the Second Circuit, sustaining the validity of the same patent, and was also believed to contain substantial error, both of fact and of law, which resulted in the decision of non-infringement of the other claims. Hence, the proceedings which resulted in the issue by this Court of a writ of *certiorari* (Rec., p. 890), and by which the cause is now here for review.

Assignments of Error.

The assignments of variance and error set forth in the petition for writ of *certiorari* are as follows, so far as is necessary to present the questions here urged :

FIRST. As to the validity of claim 2 of the patent in suit, No. 360,070, as matter of law, on the face of such claim, the decision of the Court of Appeals for the Fourth Circuit is, in terms, and apparently in scope and effect, irreconcilably at variance with the holding of the U. S. Circuit Court of Appeals for the Second Circuit.

And herein your petitioners submit the following extract from the opinion of the Court of Appeals for the Fourth Circuit, in the cases Nos. 131 and 134, now sought to be brought before your Honorable Court by writ of *certiorari* :

" We think that when claim 2 of 360,070, in its language describing the action of that device, failed to describe any means by which the extreme traverse of the piston produced it, declaring merely that the piston ' by a further traverse, admits air directly from the main

air pipe to the brake-cylinder,' it was fatally defective, claiming only a result which is public property, and not identifying the specific means (his own property) by which the result is achieved."

In the Court of Appeals in the Second Circuit, this claim 2 of Patent 360,070 was held to be valid.

SECOND. As a matter of error herein, your petitioners submit that the said decision of the said Circuit Court of Appeals for the Fourth Circuit, that said claim 2 of Patent No. 360,070 is "fatally defective" in matter of form, or in the substance thereof, is not well founded in fact or in law.

THIRD. As further matter of error herein, your petitioners respectfully submit that manifest error was made by the said Circuit Court of Appeals for the Fourth Circuit, in its rulings as to the effect of the proceedings in, and action of, the U. S. Patent Office, and herein:

(1) That error was made in holding as matter of law or fact, without proof, that the said Patent Office "employs the best experts in mechanics which it can secure in this and other countries."

(2) That error of fact was made in holding that the examinations made in the U. S. Patent Office, though "*ex parte* in form," are "nevertheless conducted under hot and skillful contestation in every case of importance."

(3) That, possibly by these errors of fact, error of law was made wherein it was held by the said Court that, in granting a later patent to Boyden, without notice of any kind, "that action by the Office was in effect a ruling that the Boyden device did not infringe Westinghouse Patent here in suit, No. 360,070."

(4) Further error was made in holding, as a matter of evidence, that "that ruling [of the Patent Office] takes rank here as the testimony of experts of the highest experience, skill and knowledge in mechanics."

FOURTH. And, as matter of error and variance herein, your petitioners respectfully represent that the force and meaning of the phrase



"substantially as set forth," as explained and applied by the said Circuit Court of Appeals for the Fourth Circuit, is directly at variance with the decisions of this Court, and is in error as matter of law.

FIFTH. As further matter of error herein, and as a matter irreconcilably at variance with the ruling of the Circuit Court of Appeals in the First Circuit, your petitioners further submit that manifest error was made by the said Circuit Court of Appeals for the Fourth Circuit in holding, as matter of law, that *the mere erasure*, from the original specification, of a description of a proposed modification operates as a *disclaimer* of such modification.

SIXTH (original Eighth). The Court erred in holding that defendants' apparatus was not an infringement of claims 1, 2 and 4 of complainant's patent, and each of them.

As a further assignment of error (included in the original assignment of error before the Court of Appeals, Record, p. 862) we say :

SEVENTH. The Circuit Court of Appeals erred in not holding each of the claims Nos. 1, 2 and 4 of Patent No. 360,070 valid and infringed by the defendants.

These original assignments of error involve, in one form or another, the following material issues :

1. As to the *character, originality and extent* of the invention as made.

2. *As to the scope and proper construction of the Patent 360,070 granted therefor.*

The *validity* of the patent is not contested in the proofs, and the answer denies it only *pro forma*.

3. As to infringement.

As sub-heads, under the three issues thus stated, and collateral thereto, are the following :

4. The effect on Patent 360,070 of certain proceedings in the Patent Office in connection with the application therefor.

5. The effect of a patent granted to defendants, which was applied for *after* the suit was brought—all proceedings therein being *ex parte*.

It is believed that under the foregoing may be included all the questions, the consideration of which is desired in the present proceedings.

History of the Westinghouse Air Brake.

The Westinghouse air brake has been developed through three forms or types, and the invention here in question relates to the perfected results.

The earliest form or type of the Westinghouse brake is referred to herein as the "plain" or "straight-air" brake.

The second type is that known as the "automatic" brake.

The third or final type is that known as the "quick action" or "emergency" brake. This final type of brake is the one patented in the patent in suit.

That Westinghouse invented them all—the "plain" or "straight-air," the "automatic" and the "quick-action" as well—is not denied.

Practically, he *created* the art of controlling the movements of trains by fluid pressure, and has also *perfected* it.

His exclusive right to the "plain" brake was established in *Westinghouse vs. Gardner & Ranson Co.*, 9 Pat. Off. Gaz., 538.

His exclusive right to the "automatic" brake never became a matter of litigation.

His exclusive right to the "quick-action" brake has been repeatedly affirmed, and affirmed in every case where the question has arisen.

In the present case, the Court of Appeals for the Fourth Circuit do not *deny* the right; they were of opinion that one claim was

"fatally defective," and the others *too limited* to embrace the defendants'.

In both these points, we submit they were in error.

A brief statement of the salient features of these three brakes will aid materially in an understanding of the present issues.

THE "PLAIN" OR "STRAIGHT-AIR" BRAKE.

In this there was an air-compressing pump, operated by steam from the locomotive boiler, by means of which air was compressed into a comparatively large reservoir, to a pressure of about eighty pounds per square inch. This reservoir, being still used, is now known as the "*main*" reservoir. From it an air pipe, sometimes called a "train pipe" led up into the cab, through the "*Engineer's Valve*," and thence down and *back* under the tender and cars, being united *between* cars, by India-rubber hose and metal couplings. These couplings were, and still are "automatically detachable;" that is, while they kept their grip or hold on each other, under the strains incident to the ordinary running of the train, they would readily pull apart under unusual or abnormal strains—as when a car coupling broke, and the train pulled in two.

Each car had a "Brake Cylinder," which contained a piston, the stem of which made connection with the ordinary brake levers. The piston was moved, so as to apply the brakes, by means of air pressure admitted into the forward end of the brake-cylinder, through a branch from the "main air" or "train" pipe.

A valve known as the "Engineer's Valve" was inserted in the line of this air (or train) pipe in the cab, and within easy reach of the engineer. When the brakes were to be applied the engineer shifted this valve so as to let the compressed air flow from the main reservoir back through the train pipe into the brake cylinders of the several cars, so as thereby to push back the pistons, actuate the brake levers and apply the brakes.

To release the brakes, he reversed his engineer's valve, and let

the compressed air escape from the brake cylinders by flowing forward along the train pipe to the escape port of the engineer's valve, and thence out to the atmosphere.

To "slow down," or hold his train in check and under control on a long down grade, the engineer made what may be called a *partial* application of the brakes. He admitted, say twenty, thirty or forty pounds of pressure to the brake cylinders—just as much or as little as he found to be necessary—and then *closed* his valve, so as to *hold that pressure*, without increase or diminution, till the occasion for slow speed was passed, or the foot of the grade was reached. This is commonly called "*graduating*." It means operating the brakes with a "*graduated*" pressure, or a pressure *less than the maximum*.

Hence, with the "plain" brake, if the engineer wished to stop *quickly*, he turned on the *full pressure* of eighty pounds, and turned it on as rapidly as he could make it effective.

If he wished to stop *slowly*, he turned on the pressure slowly.

If he wished to "graduate," that is to "slow down" without stopping, he turned on only a part of the pressure, much or little, as he might think necessary.

All three, that is a "quick" stop, a "slow" stop, or "graduating"—slowing down with *no* stop—all involved the same operation. In each and every case air pressure *direct from the main reservoir on the locomotive* was admitted to force forward the piston of the brake cylinder under each car, and so apply the brakes. As between the "quick stop," "slow stop" or "graduating" action, there was only a question of degree.

These were the leading appliances which made up the "plain" brake, as involved in *Westinghouse vs. G. & R. Co.*, 9 O. G., 538.

The Court of Appeals correctly described this brake in their "statement" accompanying the opinion (Rec., p. 870).

THE WESTINGHOUSE "AUTOMATIC" BRAKE.

The "plain" brake answered its purpose in passenger car use for some years, but certain exigencies were encountered, in railway train service, which it failed to meet.

1st. For the stopping of trains it was sometimes too slow. The time required for the flow of *enough* air, even under high pressure, from the main reservoir on the locomotive, back to each of the successive brake cylinders of the train, and especially to the *last* ones, was considerable; it averaged fully *one second per car*. A train moving at the not unusual speed of fifty miles an hour is going over seventy feet per second. Hence, with the "plain" brake on a ten-car train, an engineer could not, even in the most alarming emergency, get the brakeshoes into any effective contact with *all* the wheels until his train had run a little more than one-seventh of a mile, and it was *after that* that the braking or stopping had to be done. It was of the highest importance, in times of impending danger, to save the ten seconds thus wasted while running that one-seventh of a mile.

2d. It depended for operation on air pressure *from the locomotive*. Trains meet with accidents. A car coupling breaks and the train pulls in two. While the engineer may easily, with the "plain" brake, stop the *forward* portion, or the section which remains connected to the locomotive, how is the rear portion to be stopped so as to avoid a dangerous collision by running into the front portion? This was an exigency or emergency for which the "plain" brake made no provision.

These with other defects or imperfections led Mr. Westinghouse to the invention of the "automatic" brake. How did he do it?

Retaining nearly all the mechanism which belonged to the "plain" brake, he altered radically its method of operation, and he added to it two mechanisms which largely remedied the defects above noted.

FIRST. He put *under each car* an air reservoir of sufficient capac-

ity to hold at least enough compressed air for *one operation of the brakes of that car*. Hence, when he wished to apply the brakes, the air necessary for doing the work was already present on, and distributed along, the several cars, and the delay of transmitting it back from the main reservoir on the locomotive through the long train pipe was wholly avoided. This saved the ten seconds, more or less, of time above referred to.

And as this car reservoir was *auxiliary* to the *main* reservoir it came to be known as the "auxiliary reservoir," and is so designated in the testimony herein.

SECOND. The other mechanism which Mr. Westinghouse added to the "plain" brake, so as to produce the "automatic," consists of what was then termed, and is still known as, a "triple valve," so called because, inserted at the junction of three pipes, it automatically controls the orderly flow of compressed air in three directions, by opening and closing, at proper times, three ports or valve openings, and thereby automatically effects or secures the orderly actions of the brake.

These three ports or valves are :

1. A port or valve from the train pipe to the auxiliary reservoir. This allowed the auxiliary reservoir to fill so as to be *ready* to apply brakes.

2. A port or valve from the auxiliary reservoir to the brake cylinder. This allowed flow of air to apply brakes and was called the "main valve" of the triple.

3. A port or valve from the brake cylinder to the open air. This caused the brakes to become or remain *released*.

A *considerable variety* of forms of these triple valves have been invented by Westinghouse and others, but their essential features are as above described.

The better to illustrate a "triple valve," reference may be made to the first drawing facing Record page 468, "Complainants' Exhibit Illustration Automatic Brake System," and to the middle section, marked "Ordinary Triple Valve." The three pipes entering the casing of the triple valve will be easily identified—the first coming up from the train pipe below, the second, on the left, leading to "Auxiliary Reservoir," and the third going upward to "8-in. Brake Cylinder."

With this "Automatic" apparatus, before the train starts, air pressure from the main reservoir is permitted to flow back through the train pipe. This pressure, entering the "triple valves" on all the cars (each car having its own "triple valve"), automatically shifts their moving parts so as to open the ports and passages which lead from the train pipe to the auxiliary reservoirs on all the cars, and so *charges them with full working pressure.*

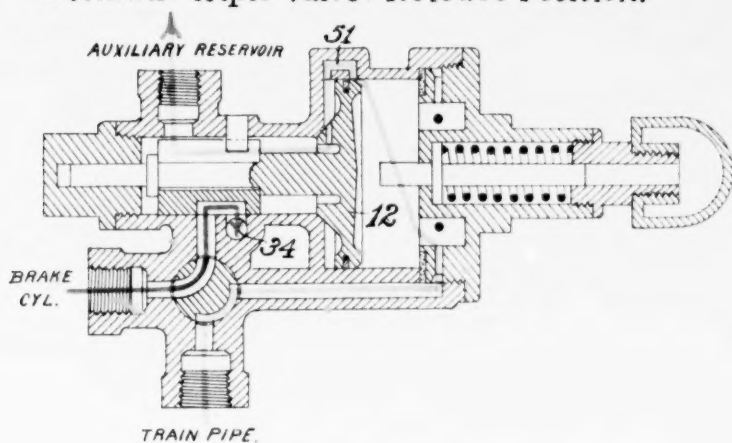
This operation may be illustrated by the use of the triple valve of Westinghouse Patent 168,359 (Rec., p. 752), merely changing, for greater clearness of illustration, the plane of the auxiliary reservoir connection from the side to the top of the case.

As will be seen, by examining the sketches, Nos. 90 and 91, opposite the following page, there are two positions of a "triple valve," by which three valvular openings or passages, for the admission or exclusion of the flow of air, are brought into action. The yellow line, sketch No. 90, shows the flow of air in the charging operation—*i. e.*, while the auxiliary reservoirs are filling up—and this position is the one which the parts maintain while the train is running, or in running order, and the brakes are "off."

This line of flow, or line of passages and ports through the triple valve, may, for convenience, be designated as *Passageway No. 1.* The port or valve which is opened is one which connects the *train pipe* with the *auxiliary reservoir.*

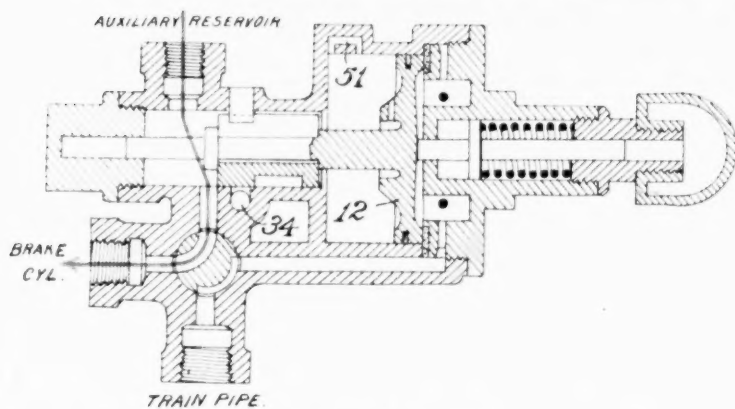
The second line of flow is from *brake cylinder* to the *external atmosphere.* This is also open when the auxiliary reservoir is being filled and when the train is in running order and the brakes are "off." It is indicated, in sketch No. 90, by the green line, and when

Automatic Triple Valve: Release Position.



Sketch No. 90.

Automatic Triple Valve: Service Position.



Sketch No. 91.

opened *releases* the brakes, and while open, keeps the brakes released, by keeping open a port or passage to the external air from the brake cylinder.

The third line of flow comes into use when the brakes are *to be applied*. The engineer then shifts his engineer's valve (not the "triple"), so as to let air *escape from the train pipe to the atmosphere*, at the engine. Then the higher, *unreduced* pressure in the auxiliary reservoir, acting backwardly, will operate the moving parts of the triple valve so as to close the port and passage leading back to the train pipe (Passageway No. 1), and close also the port or passage from the brake cylinder to the external air (Passageway No. 2), and *open* the port and passage which leads through the triple valve from the *auxiliary reservoir* to the *brake cylinder* (Passageway No. 3).

This (Passageway No. 3) is illustrated by the red line in Sketch No. 91, which represents the position of the triple-valve devices when the brakes are applied.

Passage No. 1 (Yellow line, Sketch No. 90) is closed by the back stroke of the triple-valve piston, in passing and cutting off the feed ports 51.

Passage No. 2 (Green line, Sketch No. 90) is also closed by the same movement—viz., by the valve H—cutting off the exhaust port 34.

But Passageway No. 3, indicated by a red line in Sketch No. 91, is now opened, so that compressed air may flow from each auxiliary reservoir to its own brake cylinder, and so apply the brakes.

The compressed air which thus flows from the auxiliary reservoirs to the brake cylinders constitutes the entire breaking force in the "automatic" brake which we are now describing.

As it has to flow but a short distance, it is subjected to little friction and gives greater speed of action than was obtained when the pressure had to be transmitted all the way back from the main reservoir on the engine, which was one serious defect of the "plain" brake.

In other words, it saved a large part of the ten seconds of time required in a ten-car train to do the preliminary work of bringing the brake-shoes into contact with the wheels, and thus saved nearly

the whole of the one-seventh of a mile of travel or distance previously lost, as above stated.

So much was saved as regards promptitude in getting the brakes at work.

How or why was it called "Automatic" ?

The brakes in this system are brought into action, primarily, by a *reduction*, at the locomotive, of train-pipe pressure. The engineer shifts his engineer's valve *at the engine*, so as to *vent* or *exhaust* pressure from the train pipe to the atmosphere *there*.

But it will be readily understood that if a train should pull in two, or a car become detached, the same escape of air occurs, and the same action takes place *automatically*, at the broken part, and the same result follows. Train-pipe air escapes through the separated couplings, back pressure from the auxiliary reservoirs shifts the moving parts of the triple valves, so as to apply the brakes, by *automatic action*, in the same way.

The "Automatic" brake is correctly described in the "statement" of the Court of Appeals (Rec., p. 871).

The "Automatic" brake, as thus organized, differed essentially from the "plain" or "straight" brake in its method of operation. Instead of being operated by charging pressure into the train-pipe, it was put into operation by *discharging pressure from* the train-pipe, and by such discharge of train-pipe pressure, or by merely *lessening* such pressure, the triple valves were shifted so as to charge pressure from the *auxiliary reservoirs* into the brake cylinders, and so apply the brakes.

This was wholly new with Mr. Westinghouse. It was a novelty in the mechanic arts, and, in fact, something of a paradox. But it was one of the fundamental principles of the "Automatic" brake, and gave to it, in large measure, its great success. For several years it was the standard brake of the world, and as an element or part of the "Quick-Action" apparatus, it is still a standard, conformed to and adopted by all builders of fluid-pressure train brakes.

DEFECTS OF THE AUTOMATIC BRAKE.

Such, in a general way, and omitting some details not important in the present case, was and is the Westinghouse "automatic" brake, as it has been in use now for many years in the passenger car service of nearly all the railways in this country. The results of its use in passenger trains were so beneficial, and aided so greatly in the safe and expeditious handling of the train, that, as the passenger trains became equipped, railway managers bestirred themselves with reference to securing its benefits in freight-car service.

But, here, new and unexpected difficulties were encountered.

In the development of the business of transporting freight for long distances, and especially on roads having low grades, the tendency has long been in the direction of increasing the load. This has been done, partly, by building stronger and heavier cars, and, as a result of the building of larger and stronger locomotives, capable of hauling a greater number of cars, partly, by increasing the length of trains, so that they are composed of from thirty to fifty cars, or more. Hence, when the Master Car Builders Association of the United States undertook the solution of the problem of applying power brakes to freight trains, or rather, when they called, as they did, on the manufacturers of train-brake apparatus to solve that problem for them, they prescribed, as one of the essential features which such a brake must possess, that it must be capable of operating successfully, and *in all the exigencies of use, both ordinary and extraordinary, heavy and long trains, say of fifty cars.* This gives a train length of over one-third of a mile, or so nearly *one-half of a mile* that practically it may be called that (Westinghouse, Rec., p. 117, Q. 47).

On such a train, the exigency arose for still quicker action than any which had yet been contemplated. Necessarily, the longer and heavier the train, the quicker is it necessary to exert the full pressure of the brakes; and the longer the train the greater the rapidity required in successive action from car to car. Now, while it is true that, on a passenger train of six, eight or ten cars,

the difference in time between the application of the automatic brake upon the first and last cars is so small as to be practically inappreciable, yet, when we come to a train of thirty or *fifty* cars, it is found that in *emergencies, when "quick action" is required, this interval of time becomes so great that the comparative speedy action of the automatic brake was insufficient, and failed to solve that part of the problem.*

For the ordinary work of braking—that is, for lessening the speed of a train while running, and for holding a train in check on a down grade, as also for making ordinary "station stops," as they are called—substantially the same "automatic" apparatus, which had long been employed in passenger train service, was equally applicable, and with satisfactory results, in the equipment of freight trains, even to the extent of *fifty cars in a single train.*

But it was found that when, as in the presence of a great and immediately impending danger, it became necessary to stop a very long and heavy freight train *in the shortest possible time and distance,* and when, for that purpose, the maximum braking pressure was to be brought into practical operation with the utmost celerity, the action of the automatic brake was defective. In long trains, the presence of a considerable slack motion between cars (which is especially present in freight trains, owing to their looser form of coupling, aggregating from twenty-five to fifty feet in a fifty-car train), also tended to increase the shock of the rear against the front cars (Westinghouse, Rec., p. 118). Hence, the difficulty was a double one. Train-weight and train-length both conspired to prevent a successful solution. And it was to effect such solution that a new structure and method of applying full and quick pressure was invented by Mr. Westinghouse, so that the brake, while retaining its former satisfactory work and functions, might also perform, as required, the function of "Quick Action," and this constitutes the distinguishing feature of novelty of the invention here in question.

The DEFECTS of the automatic brake are correctly set forth by the Courts of Appeals in their "statement" (Rec., pp. 872-3).

CAUSES OF THE DEFECTIVE OPERATION OF THE "AUTOMATIC" BRAKE ON LONG TRAINS.

We next inquire *why* the "automatic" brake was defective in quickness of action.

The quickness of action of a brake depends (*a*) upon the speed with which the compressed air flows or forces itself into the brake cylinder, and in so doing forces the piston home and puts the brake on, and (*b*) also upon the speed with which the braking action is transmitted from car to car.

The speed with which compressed air will force itself into the brake cylinder obviously depends, other things being equal, upon the size of the opening through which the air can rush in.

It was not found practical, however, to admit air *rapidly*, nor through a *large* aperture, *when* such air pressure was taken solely from the *auxiliary reservoir*. This fact is not denied.

There were, Mr. Westinghouse says,

"constructive reasons to limit the size of the passages in the triple valve making communication between the *auxiliary reservoir* and the brake cylinders, and for this reason a period of about three seconds was required to obtain the maximum brake force, from the time that the triple-valve mechanism commenced to admit it from the auxiliary reservoir to the brake cylinder" (Westinghouse, Rec., p. 121, fol. 182).*

* The explanation of constructive reason for a *small* opening where auxiliary-reservoir pressure only was utilized is explained in the record at some length (Record, pp. 317-320), and the fact is undisputed. Another reason is, however, understood to be as follows:

It is well known in mechanics that a large valve, governing a large opening, is not so sensitive or delicate in its operation or movements as one which controls a small opening. Now, a small opening from the auxiliary reservoir to brake cylinder was needed for the comparatively sensitive operation, which was availed of day by day and hour by hour, and perhaps every few minutes, in the ordinary running of trains, in making frequent stops, or in going over different grades, or slowing up at crossings. A large opening from auxiliary reservoir to brake cylinder, by which very quick action alone could be attained, seemed inconsistent with the sensitiveness required for everyday use: and, as very quick action was only required in emergencies, and as emergencies were not happening every day, it did not seem possible to sacrifice the conditions necessary for the proper operation of the train day by day, for the sake of greater efficiency on rare occasions.

But, in addition to quickness of application of full brake force on individual cars, there was a requirement for quick *serial* application of the brakes on one car after another. The nearer the approach to simultaneousness in action throughout the train the better. Approach to simultaneous action, depends upon the speed with which an operative change of air pressure can be made to manifest itself on *successive* cars.

The "plain" or "straight" air brake had been slow, because the operative increase of pressure was large in amount, and had to be transmitted all the way from the locomotive to the rear car of the train, and operated on the cars successively one after another, the transmission of the pressure being, of course, delayed by the friction of the air in passing through the pipes.

The "automatic" brake, as we have already seen, improved upon this method of operation, by storing the pressure, which was to apply the brakes, in an auxiliary reservoir under each car, where it was near at hand and close to the brake cylinder to be operated by it. But it was still necessary, with the "automatic" brake, that an operative change of pressure, by reduction, should be transmitted all the way from the locomotive to the brake to be applied. True, in the case of the "automatic" brake, the change of pressure was by diminution, instead of increase, and the diminution in pressure, which was necessary to cause the triple valve to shift and open the passage from auxiliary reservoir to brake cylinder, was *much less* than the increase involved in the use of the "plain" or "straight" brake; but the *distance* at which the change in pressure was to be felt was still a factor which tended to produce a certain slowness of action, because the reduction took place first at the locomotive, and its effect had to be transmitted backward through the whole train.

What, therefore, was needed for the purpose of quickening the *successive* action of the brakes, when *very quick* action was imperative, was some device, subject to control by the engineer as to its use or non-use, by which, on the occasions when it was urgently needed, and *not* at any other time, (1st) a *larger* discharge of com-

pressed air into the brake cylinder could be had; and (2d), the necessary *escape* of air, adequate to shift each triple valve successively, should take place at or near such triple valve, without requiring the escaping air to travel all the way back to the locomotive (Westinghouse, Rec., 121-2).

THE "QUICK-ACTION" BRAKE.

Mr. Westinghouse took a fundamental step in remedying the defects of prior brakes, by the so-called "quick-action" brake, which is in controversy in the present litigation.

He perceived that what was necessary was to quicken the action of the brakes, *both* on each *individual* car, and *from car to car*; and the simple but beautiful expedient upon which he hit was that of modifying the old "automatic" brake so that, while it retained all its original functions for ordinary use, it should also have the capacity, under the control of the engineer, by which, when an emergency happened and great quickness of action was required, a passage should be opened directly from the *train pipe* (filled by the main reservoir on the engine) to the brake cylinder, and through which the *train-pipe* air *in bulk* could pour into that cylinder.

This discharge of the TRAIN PIPE into the brake cylinder to produce QUICK ACTION was absolutely new with him.

This operation resulted in charging or filling the brake cylinder, and applying the brakes, more quickly than before, and, also, by reason of the fact that the filling of the brake cylinder with air from the train pipe on one car, made what was in effect a *local* vent for release of pressure sufficient to operate the valve on the next car behind, each successive valve acted more quickly than when the diminution of pressure was caused by escape of air *only* at the engineer's valve on the locomotive.

The Circuit Court of Appeals, in the opinion under review, said (R., pp. 876-7) :

"It is not for us to describe how the introduction of train-pipe air into the brake cylinder of each car quickens the action of the brakes, which are already subject to the action of air from the auxiliary reservoir. It is sufficient to say that the engineer, by means of his

valve on the engine and by means of the branch pipe leading from the train pipe to the triple valve of each car, can, by the improvements in controversy, vent the air of the train pipe directly and more promptly into the brake cylinder, and thus more quickly apply the brakes, than he can by the indirect conduit opened by the main valve of 220,556 into the brake cylinder from the auxiliary reservoir when its position is in extreme traverse, as heretofore described. Quick action being the desideratum, the engineer effects it more promptly by the direct means than by the indirect."

Broadly speaking, therefore, Westinghouse's invention of the so-called "quick-action" valve for long trains, consisted of a provision for the admission or charge of air, at the will of the engineer, *direct from the train pipe* (instead of from the auxiliary reservoir alone) into the brake cylinder. This direct access of AIR FROM THE TRAIN PIPE *permitted the use of a comparatively large opening for that purpose*, without impairing the sensitiveness of the ordinary admissions of air from the auxiliary reservoir, and resulted in not only quickening the application of the brake on each car individually, but also resulted in quickening the rate of successive application from car to car, by providing at each car a local vent for the air, sufficient to move the triple valve of the car next behind it (Rec., p. 122, fol. 184 *et seq.*)*

We next turn to see how this invention was embodied in practice in a given structure.

The Patent in Suit.

The invention of George Westinghouse, Jr., above outlined, is described and claimed in his Patent No. 360,070, dated March 29th, 1887 (Record, pp. 782-789).

The specification contains the following brief and clear statement of the objects and *essential features* of the invention, in the following words (782) :

* It is true that the feature of local venting, in order to quicken serial action, had been *attempted* in an earlier patent of Mr. Westinghouse (No. 217,838), but *unsuccessfully* ; 1st, because the discharge of locally vented air was to the atmosphere and not into the brake cylinders, and hence the force was wasted, and, 2d, because the local venting took place *at every application*, and *not only* when the engineer so willed (see opinion MORRIS, J., p. 847).

"The object of my invention is to enable the application of brake-shoes to car wheels by fluid pressure to be effected with greater rapidity and effectiveness than heretofore, more particularly in trains of considerable length, as well as to economize compressed air in the operation of braking by utilizing in the brake cylinders the greater portion of the volume of air which in former practice was directly discharged into the atmosphere.

"To this end, my invention, generally stated, *consists* in a novel combination of a brake pipe, an auxiliary reservoir, a brake cylinder, and a 'triple-valve' device governing, *primarily*, communication between the auxiliary reservoir and the brake cylinder, and, *secondarily*, communication *directly from the brake pipe to the brake cylinder.*"

Then follows a description of the Westinghouse "Automatic" Brake and its mode of operation, and following this (p. 83) is a brief statement of the defectiveness of that brake in operation when the application of *full force* is required, viz.:

"Application of the brakes with their full force has heretofore required a discharge of air from the main pipe sufficient to reduce the pressure in said pipe below that remaining in the auxiliary reservoir after the brakes have been fully applied, and it has been found that, while the brakes are sufficiently quick in action on comparatively short trains, their action on long trains of from thirty to fifty cars, which are common in freight service under present practice, is in a measure slow, particularly by reason of the fact that all the air required to be discharged from the main pipe to set the brakes must travel from the rear of the train to a single discharge opening on the engine. This discharge of air at the engine has not only involved a serious loss of time in braking, but also a waste of air. Under my present invention a quicker and more efficient action of the brakes is obtained, and air which has been heretofore wasted in the application of the brakes is almost wholly utilized to act upon the brake pistons."

The inventor then proceeds with a detailed description of the drawings illustrating his invention, or the selected form thereof.

He chooses, for the purpose of illustration, a "triple valve" which (p. 784),

"accords substantially with that set forth in inventor's patent of the United States No. 220,556, granted and issued to me October 14, 1879,"

stating, however, that (p. 784) it is not claimed as of his present invention,

"saving however as to the structural features by which it performs the further function of effecting the direct admission of air

from the main air pipe to the brake cylinder, as presently to be described,"

Further on in the specification (785-6), and after describing all of those structural features which illustrate the triple valve of the patent in suit, as one of the "automatic" variety previously invented by him, he says :

"So far as hereinbefore described, the triple valve accords in all substantial particulars with, and is adapted to operate similarly to, those of my Letters Patent Nos. 168,359, 172,064 and 220,556, and, in order that it may perform the further function requisite in the practice of my present invention, it is provided with certain additional members, which will now be described."

What now are the *essential* "additional members"?

The patentee proceeds to explain the modifications of the described form of "triple valve," which are necessary to adapt it to "the purpose of effecting the admission of air directly from the "main air pipe 2 to the brake cylinder 7, when it is desired to apply "the brakes with great rapidity and full force."

These "structural features" or "additional members" consist, *essentially*, of, FIRST, a passageway through which air can be admitted *direct, from the main air (or train) pipe to the brake cylinder*, without passing through the auxiliary reservoir, and, SECOND, such a valve arrangement, in connection with such passage, that, when the triple-valve piston makes a short or preliminary movement, the passageway direct from the train pipe to brake cylinder, controlled by said valve, will *not* be opened, while, in the event of a long or full movement of the piston, or "further traverse," as it is called, such direct passageway *will be thrown wide open to the admission of train-pipe air*, and the brake cylinder will be rapidly filled thereby.

The drawings of the patent (Fig. 2) (Rec., p. 783) are rather small, and somewhat encumbered by the numerous figures of reference, so the enlarged drawings introduced into the record, preceding page 469 (original pages 741 and 742), and whose accuracy is undisputed, are here introduced. The principal parts are colored, so as to be easily distinguished.

These drawings showing the patented valve (in the form selected for illustration) in three positions, viz. : Drawing 13, in "Release" position, or "Brakes off;" Drawing 14, in "Service application"

Auxiliary Reservoir.

Drake C.

Auxiliary Reservoir

Drake C.

position, or brakes applied by auxiliary reservoir pressure, and Drawings 15 and 16, "*quick-action*" position.

The patent speaks of these last two operations as follows (p. 787) :

"The admission of air to the brake cylinder through the passage 31" (*i. e.*, from the auxiliary reservoir), "which is opened just before the piston stem comes in contact with the graduating stem, and which corresponds to the feed passage heretofore employed, suffices for the ordinary requirements of braking in regular service. In the event, however, of its becoming necessary to apply the brakes with great rapidity and with their greatest available force, the engineer, by means of the valve at his command" (*viz.*, the engineer's valve on the locomotive), "instantly discharges sufficient air from the front end of the main air pipe to effect a sudden reduction of pressure of about twenty pounds per square inch therein, whereupon the piston 12 of the triple valve is forced to the extreme limit of its stroke in the direction of the drain cup 19, carrying with it the stem 36 and auxiliary slide valve 41, which instantly uncovers the port 42 and discharges air from the main air pipe through the opening of the check valve 49 and the passages 46 and 48 to the brake cylinder, and, each car being provided with one of these devices, it will be seen that they are successively moved with great rapidity, there being practically, on a train of fifty cars, fifty openings for discharging compressed air from the main pipe, instead of the single opening heretofore commonly used. Not only is there a passage of considerable size opened from the brake pipe on each car, whereby the pressure is more quickly reduced, but the air so discharged is utilized in the performance of preliminary work, it being found in practice that the air so taken from the pipe will exert a pressure of about twenty-five pounds in the brake cylinders."

The operations described in the above paragraph will, we think, be made more clear by the drawings opposite the next page—Diagram 10.

In these simpler drawings, all details of construction, and all figures of reference, not necessary for a clear understanding of the structure, are omitted, and the essential parts are colored, so that their changes of position in the different stages of action can be easily followed.

The access of train-pipe air is shown located at the right end of the structure, instead of the left (as in the patent drawings), simply for greater clearness.

The "main valve" of the triple is *black*. Its office is to admit auxiliary reservoir air to brake cylinder.

The "quick-action" valve is colored *red*. Its office is to admit *train-pipe air* to brake cylinder.

The release port is colored *green*. Its office is to discharge air from brake cylinder, in releasing the brakes.

The flow or movement of air, in the several positions of the structure, is also shown by colored lines and arrows, viz.:

Air released from brake cylinder to open air by *green* arrow.

Air flowing from auxiliary reservoir to brake cylinder, in "service" application of the brakes, by *red* line. And air flowing from train pipe to brake cylinder in "quick-action" application by *blue* line.

As will be seen from the above description and drawings, in order to make possible either action or *non-action* of the emergency features, *at the will of the engineer*, Mr. Westinghouse *availed himself of the capacity of the triple-valve piston for varying lengths of travel*.

This double movement was not in itself new, but in his new combination he enabled it to perform a new function.* He provided that the triple-valve piston, when operated by only a *slow or moderate* reduction of pressure, and when making only a *short* or "preliminary traverse," shall open and close the passageways, corresponding to Nos. 1, 2 and 3 in Sketches Nos. 90 and 91, by which the "auxiliary" reservoir was opened to, or cut off from, the brake cylinder; but, when moved by a *sudden or large* reduction of pressure, and given a *longer* or "further traverse," when and only when an alarming danger is near, it shall then *open a passage directly from the train pipe*, and thereby charge *train-pipe air directly into the brake cylinder*.

This gives what is known in this case as "Quick Action."

When only the regular service work of the brake is required, the engineer accomplishes this by a moderate or slow reduction of press-

* The Court of Appeals attributed to Judge MORRIS, in the Circuit Court, the error of supposing that the double traverse of a triple-valve piston was in itself new.

In this they were themselves in error. What Judge MORRIS said was (Rec., p. 846): "It is shown that Westinghouse was the first to use a further traverse of the triple-valve piston to perform the operation required to vent the train pipe into the brake cylinder" (see, also, p. 847).

sure—say two, three or five pounds. This will cause the triple-valve piston to move through its “ preliminary ” traverse, and does all the work required in the normal running of even a fifty-car train.

But when serious danger impends, the engineer makes a sudden or considerable reduction of pressure—say fifteen or twenty pounds, more or less—and then the triple-valve piston makes a longer movement or “ further traverse,” and comes back with such force as to compress spring 39 and push valve 41 off its seat. The *direct access from train pipe* to brake cylinder is then open. Air rushes quickly and *in bulk*, as it were, from the train pipe to each brake cylinder, with the result : *

FIRST. Of charging the brake cylinders with air pressure taken direct from the train pipe, increasing the efficiency of the brake by fully *twenty* per cent., by increasing its quickness in reaching full pressure (Rec., p. 124, fol. 186).

SECOND. That, by making a *new vent* at the triple valve of the *first* car, the reduction of train-pipe pressure at the triple valve of the *next* car is hastened, and the action of *its* triple valve is speeded. This second vent on the *second* car hastens, in like manner, the action of the triple valve on the *third* car, and so on from car to car throughout the train. In this way, the average time of transmitting the braking force and getting the brake shoes into actual engagement with the wheels on a fifty-car train was at first reduced from twelve to *six* seconds (Rec., p. 125), and was finally reduced to *two* seconds, or to the *one twenty-fifth* part of a second per car (Record, p. 134, fol. 201).

THIRD. This increased celerity in action and in power of application are placed *under the absolute control of the engineer*, by being so incorporated into the structure of the automatic brake that the latter retains *for service use* all the essential qualities and functions which especially fit it therefor, but has the superadded function of admitting train-pipe air *for emergency use*, by the opening of a direct

* See, for a further explanation of diagram 10, pages 54, 55 of this brief.

passage therefrom, *when* the piston makes its longer movement or "traverse."

These are the three things which, from a practical standpoint, make the Westinghouse "quick-action" brake, and these are the three points around which are centred substantially all the matters involved in the present controversy.

The specification, before making the claims, contains a generic clause, showing clearly that, within the contemplation of the inventor, the invention which he had made was not one which was confined to or limited by the special construction of the special triple valve which he had selected for the purposes of illustration. He says (p. 788) :

"In using the terms 'triple valve' and 'triple-valve device' I refer to a valve device, however specifically constructed, having a connection with the main air or brake pipe, another with an auxiliary reservoir or chamber for the storage of power and another with a brake cylinder or its equivalent for the utilization of the stored power and with a release or discharge passage for releasing the operative power from the brake cylinder, whether the valves governing these passages or connections are arranged in one or more series and are moved by a piston or its equivalent or by cases of pistons or their equivalents, there being numerous examples in the art of constructions, varying materially in appearance, whereby these functions are performed, both in plenum and vacuum brake mechanisms."

The inventor then states that his invention may be utilized in brakes which work by atmospheric pressure as well as those working by air under artificial compression, but he disclaims a construction of brake mechanism in which a passage from the main air pipe is *always* open, as this, he says, "involves an operation different from that of my invention." He then proceeds with his claims (p. 788), of which the 1st, 2d and 4th are as follows :

"1. In a brake mechanism the combination of a main air pipe, an auxiliary reservoir, a brake cylinder, a triple valve and an auxiliary valve device, actuated by the piston of the triple valve and independent of the main valve thereof, for admitting air in the application of the brake directly from the main air pipe to the brake cylinder, substantially as set forth.

"2. In a brake mechanism the combination of a main-air pipe, an auxiliary reservoir, a brake cylinder and a triple valve having a piston whose preliminary traverse admits air from the auxiliary

reservoir to the brake cylinder, and which, by a further traverse, admits air directly from the main air pipe to the brake cylinder, substantially as set forth.

"4. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake cylinder and to the atmosphere respectively, and an auxiliary valve actuated by the piston stem and controlling communication between passages leading to connections with a main air pipe and with the brake cylinder respectively, substantially as set forth."

Nothing, as it seems to us, can be clearer than the scope of this invention and the meaning of the claims.

The inventor does not assert that he is, in the present specification, describing for the first time an air brake, nor an "Automatic" air brake; nor an air brake which may admit varying amounts of air from *auxiliary reservoir*, according to the varying movements of the triple-valve piston; nor a triple valve the length of whose piston movement could be varied.

All these things were old, and had been previously described or patented by himself.

What had *not* been done was to obtain "*quick action*" by the direct admission of *train-pipe air*.

He *now* asserts that he has produced, and described and illustrated in *one* form,

"A novel combination of a brake pipe, an auxiliary reservoir, a brake cylinder and a 'triple-valve' device governing, primarily, communication between the auxiliary reservoir and the brake cylinder, and, *secondarily*, communication directly from the brake pipe to the brake cylinder."

The preamble to the claims states in distinct terms that his invention is not embodied in a device in which train-pipe air is *always open* to the brake cylinder, and in which communication from the train pipe to the brake cylinder is simultaneously and *always opened* when the piston of the triple valve moves to open communication from the auxiliary reservoir.

The gist of the invention, and the vital point of its novelty, as contained in the preliminary statement of that in which it "consists," is that, in a combination of brake pipe, auxiliary reservoir, brake

cylinder and "a (*not* "the") triple-valve device," such triple-valve device shall "*govern*" primarily (that is, by its primary movement) communication from the auxiliary reservoir to the brake cylinder; and, secondarily (that is, by a secondary movement), communication direct from the brake pipe to the brake cylinder.

There is no mistaking the meaning of those words.

Taken in connection with the statement preceding the claims, in which the inventor expressly states that his invention is not limited in its application to the special form of "triple-valve" illustrated by him, but may be embodied in any "triple-valve devices," whether contained in one or several cases, or worked by one or several pistons, it is clear that the invention is not limited to any particular form or location of the new communication direct from train or brake-pipe to brake cylinder, nor to any particular form of valve for uncovering such direct passageway, when the direct admission of train-pipe air is to be effected.

True, in the illustrative form portrayed in the drawings, the direct passageway from train-pipe to brake cylinder is shown in the *outside* of the casing of the ordinary form of "triple-valve" illustrated, and the valve which closes and uncloses that passageway is outside of the ordinary triple-valve chamber, and is *pushed* off its seat, when required, by a supplemental stem, attached to the front of the triple-valve piston.

But, clearly, these details are not of the *essence* of the invention.

The essence "consists" in the fact that the triple-valve device, however it may be varied in form, and while retaining its well-known characteristics, shall "govern" (*i. e.*, control, at the will of the engineer, by some suitable form of connection), primarily, the port for discharge of air from the auxiliary reservoir to brake cylinder, and, secondarily, the port for discharge of air from the train-pipe to the brake-cylinder.

That the invention may be embodied in a variety of forms, without losing its essential character or necessary elements, will, we think, be evident from a few illustrations.

Two of these are shown in the opposite illustrative diagrams, Nos. 2 and 3, which are not in the record, but which serve to explain our position.

Diagram 2 shows a form in which the passage from the train-pipe to brake-cylinder is at the opposite end of the triple-valve device, but this clearly embodies the same invention.

So, again, the form of valve may be changed from a slide valve to a poppet and the invention will be clearly used, as shown in the next following figure (Diagram 3).

The picture of the valve of the New York Air Brake Co., shown in the opinion of the Circuit Court of Appeals (Rec., p. 883), is a still less closely related form, but was, apparently, conceded by the opinion below to embody the same invention, although the emergency valve was very differently located and was operated by air pressure only, made effective by the "further traverse" of the triple-valve piston.

Clearly, therefore, this invention is one which is not to be too closely tied to particular mechanical forms. It may be embodied, as expressly stated, in a great variety of forms. Its essential characteristics are, however, clearly stated, and the skill of the mechanic art is adequate to express the invention in a great variety of ways.

Doubtless, subordinate invention may be exercised in devising details of arrangement of passages, shape and location of valves, to promote compactness and convenience of the structure; but whenever the essential structural characteristics of the invention above described are found embodied in an "automatic" brake mechanism, whose triple valve "primarily controls the passage from auxiliary reservoir to brake cylinder, and, secondarily, controls the direct passage from train or brake-pipe to brake cylinder," there the invention of Westinghouse is found, and that invention cannot be obscured, nor the claims of the patent (if they be properly expressed) evaded by the ingenuity with which the respective "communications" or passages may be disguised, or the form and location of the valves which control them be modified.

This new invention of Westinghouse is expressed in and covered by the claims.

The second claim perhaps defines it more nearly in the language of the preamble of the patent than any other.

That second claim is in the following words :

"2. In a brake mechanism the combination of a main air-pipe, an auxiliary reservoir, a brake cylinder and a triple valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake cylinder, and which by a further traverse admits air directly from the main air pipe to the brake cylinder, substantially as set forth."

Obviously, that claim is not to be limited to the special passages or the special shape of valves chosen for illustration, nor to the pushing of the valve from its seat by an additional "piston-stem." If any brake mechanism, which is to be compared with that claim, contains the combination of a main air-pipe, an auxiliary reservoir, a brake cylinder and a "triple valve" having a piston; and if there be in the structure passages or "communications," *both* for admitting air from the auxiliary reservoir to the brake cylinder and *also* for admitting *train-pipe* air direct to the brake cylinder; and if the structure be such that the preliminary movement of the triple-valve piston (by acting through some suitable or well-known instrumentality) uncovers a communication or passage which only admits auxiliary reservoir air, while the secondary, or "further traverse" (in like manner) uncovers a passage which admits *train-pipe* air, then the essential "structural features" of that claim are present, and the invention of Westinghouse, as defined in the second claim, with all its great advantages, is found, irrespective of the special mechanical connections between the "triple valve" piston and the operating parts or valves, or of the character of those valves, or of the *particular* shape or *exact location* of the "communications" which are opened.

The first claim also states the invention of Westinghouse from another point of view, and defines a special embodiment of it. It is in the following words :

"In a brake mechanism, the combination of a main air-pipe, an auxiliary reservoir, a brake cylinder, a triple-valve, and an auxiliary-valve device, actuated by the piston of the triple-valve and independent of the main valve thereof, for admitting air in the application of the brake directly from the main air-pipe to the brake cylinder, substantially as set forth."

Here, the statement of the new invention is not defined by the requirement that the piston of the "triple valve" should have a "preliminary," and also a "further" traverse, or that the "preliminary traverse" shall govern one passageway, and the further traverse shall govern another.

The inventor is mindful of the fact stated in the preamble of his claims, that the "triple valve," properly so-called, may consist, not solely of a structure containing a *single* piston with *double traverse*, but may consist of a structure having a *series of pistons*, as well as a structure having a *single piston*.

He, therefore, here states his invention in terms which are applicable to either or both of such forms of structure, and defines his invention as one in which, in addition to a valve which admits air from the auxiliary reservoir to the brake cylinder (which is a function commonly performed in the older structures by what is known as the "main" valve of the triple), there shall be an "auxiliary valve" device, actuated by a triple-valve piston, *which shall admit air directly from the main air or brake pipe to the brake cylinder*.

In this claim, the feature of the invention, which is specifically pointed out and made the subject of the claim, is the fact that the direct admission of train-pipe air is effected by a valve "auxiliary" to that which is *primarily* relied upon to admit auxiliary reservoir air (called the "main valve").

In this claim the double traverse of a single piston is not required. It contemplates the possible utilization of *two* pistons, as stated in the preamble to the claims.

In the second claim, on the contrary, the inventor perhaps contemplated the possibility of the separate passages or communications from auxiliary reservoir to brake pipe being closed by a single physical valve-structure, although the opening of the two separate

communications was to be governed, one, by a "preliminary," and the other by a secondary or "further" traverse of the triple-valve piston.

Both claims together seem to adequately protect the invention of Westinghouse, so far at least as the present litigation is concerned.

Each points out *certain essential* features which were new with Westinghouse, and some or all of which were necessary for the production of his new result.

The fourth claim follows the line of the first claim with greater detail and particularity of description, and needs no further special attention, except to again recite its terms, which are as follows:

"4. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake cylinder and to the atmosphere, respectively, and an auxiliary valve actuated by the piston stem and controlling communication between passages leading to connections with a main air pipe and with the brake cylinder, respectively, substantially as set forth."

The invention of Westinghouse, of the quick-action brake, is a "pioneer" invention, or one fundamental in character.

This point is so fully admitted in the opinion of the Circuit Court of Appeals, which is now before this Court for review, that lengthened discussion is unnecessary.

The Court of Appeals, while considering what is regarded as "fatally defective" *language* of the second claim of the patent in suit, yet conceded, in express terms, the commanding value and primary importance of the invention itself. It said (Record, p. 880):

"That this invention of Westinghouse, thus undefined, is one of the highest value to the public, and that it is a pioneer one in the art of quick-action brakes is not denied, and is conceded.

"It is conspicuously one of those pioneer inventions which entitle the proprietor to a liberal protection from the Court in construing the claim."

These words involve none too high praise of the invention of

Westinghouse, which is admitted to be first disclosed in the patent in suit.

An invention which resulted in placing it within the power of an engineer, running a train of 50 cars, to stop such a train in about half the time and half the distance (Rec., p. 127-8) within which any similar train had been previously stopped, is deserving of the public gratitude.

When it is considered that freight trains of such length have become the ordinary methods of transportation, and that, upon their safe running, hundreds, if not thousands, of millions of dollars' worth of property, and tens of thousands of valuable lives, are dependent, the inventor who has contributed in any marked degree to the protection of such lives and the preservation of such property, is entitled to all of the consideration, by way of a fair, and even liberal, construction of his claims, which Courts are able to accord to him, within the established rules of law.

As was said by the late Mr. Justice BLATCHFORD, sitting at Circuit in another case (*Poillon vs. Schmidt*, 6 Blatch., p. 303) :

"The invention as set forth in the Specification is a highly meritorious and useful one, and one which the Court will desire to sustain if consistent with the principles of law."

Judge MORRIS, in the present case, at Circuit (Record, p. 845), used the following language in regard to this invention :

"Now, although quick action emergency brakes were being sought for, no one before Westinghouse had accomplished this result, and the means by which he accomplished it were entirely novel. Indeed, upon first impression it is paradoxical and startling to find that, when a sudden, quick and powerful action of brakes is needed in the face of impending danger, it is to be obtained by a sudden large release of pressure in the train pipe, to the extent of 15 or 20 pounds below that in the auxiliary reservoir, and that by using this low pressure air to operate the brake cylinder, instead of the air under greater pressure stored up in the auxiliary reservoir, this remarkably effective application of the brakes is obtained. In the domain of quick action brakes this device would seem to belong to that class of pioneer inventions the patents for which are to be construed so as to be coextensive with the real invention, if the language of the claim will permit it."

The Circuit Court for the Southern District of New York (LACOMBE, J.), in *Westinghouse vs. New York Air Brake Co.*,

65 F. R., 99, in considering *both* inventions of Westinghouse relating to the quick action brake, viz., the one now before the Court, of Patent No. 360,070, and the later improvement of Patent No. 376,837, said, as follows, and in saying this, he was referring to the opinion of the Court of Appeals, Second Circuit, 63 F. R., 962:

"In those opinions it is held that the two patents 360,070 and 376,837 disclosed, the one the emergency valve, the other the supplemental piston or special motor, which, so far as the art has now progressed, appear to be both essential to the structure of a successful quick-action brake. Both of these inventions achieved great necessities and overcame great hindrances; each is an indispensable part of the 'bridge which carried railroad-car builders from failure to success;' both were products of the inventive genius of the same man; nothing anticipating either is shown."

* * * * *

"Although 360,070 was not declared upon in the earlier suit, it was discussed at great length, and its meritoriousness was clearly recognized. The statements of the problem to be solved as it stood prior to January, 1888, and of the contribution of 360,070 to that solution, as they are set forth in the opinion above cited, leave no doubt that both the Circuit Court and the Circuit Court of Appeals regarded it as a patent of wide breadth; the only difficulty being to find sufficient standing room within the field it occupied to permit according to 376,837 also the necessary breadth of construction to cover the infringing devices then before the Court, and thus save to a meritorious inventor the fruits of his novel and most useful invention."

Under such circumstances, the utmost liberality may be used in dealing with the construction of the claims, and when, as in this case, the *fundamental means*, to wit, the utilization of train-pipe pressure for the purpose of effectuating the quick-action of the brakes, by admission directly to the brake cylinder, in advance of, or simultaneously with, the admission of auxiliary-reservoir pressure, are under consideration, the Court will not confine the invention with unnecessary rigidity to the particular mechanical instrumentalities by which the admission of this new source of air pressure is obtained.

"Means must necessarily be shown in the Specification, but the identical means, or the special devices, were not, in the language of

Machine Co. vs. Lancaster, 129 U. S., 263, 'necessary constituents' of the invention, either in the specification or in the Claim."

Westinghouse Co. vs. New York Co., 63 F. R., 969.

"If the invention is broad and primary in its character, the range of equivalents will be correspondingly broad, under the liberal construction which Courts give to such inventions."

Miller vs. Eagle Co., 151 U. S., 189.

Even a subsequent, and in some respects less important, invention of Westinghouse embodied in his second "Quick-Action" Brake Patent No. 376,837, was held by the Circuit Court of Appeals for the Second Circuit to entitle the inventor to a wide range of equivalents.

In *Westinghouse Co. vs. New York Co.*, 63 F. R., 969, the Court said :

"The skill and mechanical ingenuity of constructors of locomotives can, as will be seen hereafter, in the examination of other patents and of the infringing devices, arrange different details of mechanical construction by means of pistons, valves, ports and springs, which, adopting the supplemental chamber system first conceived and embodied by the patentee, and a kindred but not precisely the same mechanical method for the movement of the piston, will accomplish the same result. The patentee was a pioneer, in that he designed in No. 376,837 a new way to accomplish a desired result, but upon the same general idea which he had unsuccessfully tried to work out in the earlier patent. His later patent was the bridge, and not a mere step, which carried railroad-car builders from failure to success. It is not important now to determine the grade of its pioneering, and whether it may be classed in the list of those inventions which are of the highest rank; but it was an invention created to achieve great necessities and overcome great hindrances, and was one of wide breadth. A Court will not be justified in adopting 'a narrow or astute construction' which should minimize the character of the invention, leave its real scope open to trespassers, and thus 'be fatal to the grant.'"

This phraseology is even more fully and justly attributable to the invention of the present patent in suit.

The Burlington Trials.

The history of the trials of air brakes which resulted in the patent in suit is fully described in the record (*Westinghouse Record*, pp. 117-131).

ented devices—utility. *But it contained a valuable invention and was afterwards improved in details, when patented in number 376,837, as to become a machine of great value to the public, a supplemental piston being supplied in 376,837.*"

This qualified denial of "utility" is, however, conceded later in the opinion in the following words (Record, p. 880, fol. 1419):

"That this invention of Westinghouse, thus undefined, is one of the *highest value* to the public, and that it is a pioneer one in the art of quick-action brakes, is not denied and is conceded. It is conspicuously one of those pioneer inventions which entitle the proprietor to a liberal construction from the courts in construing the claim."

In *Westinghouse vs. New York Co.* (59 F. R., 581, 612), Judge TOWNSEND, commenting upon the apparatus of this patent, said (p. 591):

"But it also appears that these defects were not occasioned by any inherent defect in the construction of the device shown in Patent No. 360,070, and that, when the necessary parts were afterwards adjusted, and, as testified by Mr. Westinghouse, 'when the passages through the quick-action portion of the triple valve were made sufficiently large,' practically the same results were obtained in train stopping as were subsequently obtained by the kind of valve shown in Patent No. 376,837."

In a subsequent case between the same parties, based upon a new infringement, Judge LACOMBE, in granting the preliminary injunction asked for by the Westinghouse Company, said (*Westinghouse vs. New York Co.*, 65 F. R., pp. 99, 104) (p. 100):

"It is unnecessary to enter into any elaborate statement of the history of the art, and of the impress left upon it by these inventions. That entire subject has been discussed with great care, and set forth at great length in the former opinion of this Court and of the Court of Appeals, delivered in the earlier actions between the same parties (59 Fed., 581; 63 Fed., 962). In those opinions it is held that the Patents 360,070 and 376,837 disclosed, the one the emergency valve, the other the supplemental piston or special motor, which, so far as the art has now progressed, appear to be both essential to the structure of a quick-action brake. Both of these inventions achieved great necessities, and overcame great hindrances; each is an indispensable part of the 'bridge which carried railroad car builders from failure to success'; both were products of the inventive genius of the same man; nothing anticipating either is shown."

This opinion was confirmed by the Circuit Court of Appeals (*New York Co. vs. Westinghouse*, 69 F. R., 715).

That a pioneer invention need not necessarily appear, upon its first trial, in its most perfect form has been distinctly ruled by this Court.

In the *Telephone cases* (126 U. S., p. 535) this Court said :

"The law does not require that a discoverer or inventor, in order to get a patent for a process, must have succeeded in bringing his art to the highest degree of perfection."

In *Mergenthaler Co. vs. Press Co.* (57 F. R., p. 506), the Court said :

"It would certainly be a novel doctrine to deny to an inventor the fruits of a broad invention because the machine which first embodied it was rudimentary in character, and failed to do as good work as improved machines made subsequently. None of the great inventions could survive such a test. Ten years after the invention of Howe, the machine first made by him would hardly have satisfied the least exacting sewing woman. The Dodds and Stevenson locomotive would, only a short time after its construction, have been discarded as behind the age, even by the savages of Tasmania. The telephone of Bell is not the perfected telephone of commerce; the Morse telegraph is to-day looked upon as an interesting antique. And yet, it would be an unheard of proposition to withhold from these illustrious men the credit they deserve because their machines were crude at first and were improved afterwards."

The defendants cannot, therefore, gain anything by commenting upon the defects which manifested themselves in the initial trial of the apparatus of the patent in suit; defects, as is seen, which were shortly remedied by the same inventor, and so promptly and perfectly remedied that at the time the testimony was taken, between 1500 and 1900 of these valves were in actual use (Rec., p. 149, x-Qs. 169, 170).

And the only change required for the purpose was purely a mechanical change—merely the enlargement of a port which was too small (Rec., p. 152, fol. 228).

The decision of Judge MORRIS herein was obviously correct, and, as we submit, should be affirmed. It runs thus (Rec., p. 851):

"It has been urged that the invention disclosed by the patent in suit is not of a meritorious character, because in the form in which it is there embodied, or at least in the first mechanism manufactured by Westinghouse, it failed of success in some essentials, and was immediately improved by Westinghouse in a manner which was the subject of a subsequent patent before it was successful in the use

for which it was intended. The defect developed by experimental test and which Westinghouse in a few months remedied was that the opening uncovered by the auxiliary valve was not sufficiently large to suddenly release the full volume of train-pipe air. This was not a defect inherent in the device (59 Fed. Rep., 581-591).

The Defendants' Valve, Its Structure and Mode of Operation.

We have now considered the Westinghouse invention, its general character and essential features, and the position of Mr. Westinghouse as an inventor.

We are next prepared to consider the defendant's structure.

In this connection, it is fair to observe that the defendants' valve has been patented.

The patents of Boyden relating to his type of valve are found in the record, No. 481,134, dated August 16, 1892 (R., p. 797); No. 481,135, of August 16, 1892 (R., p. 809), and No. 481,136, dated August 16, 1892 (R., p. 817).

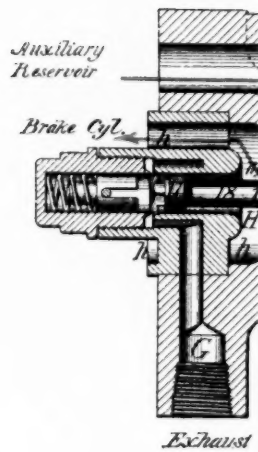
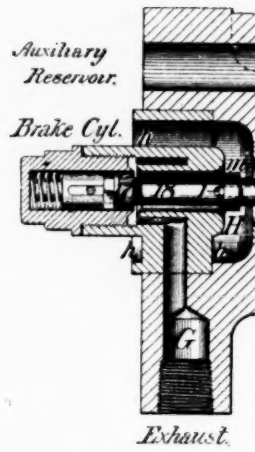
All of these patents were granted more than two years and a half after the commencement of this suit; and all of them, except the first, were applied for, more than a year after the commencement of this suit; and the first one, namely, No. 481,134, was applied for on September 30, 1889, and this bill was filed on December 12, 1889.

In each of the patents, Boyden endeavors to distinguish his valve, and its theory of operation, from that described and claimed in the Westinghouse Patent No. 360,070.

What effect of weight should be given to the statements in these patents, and to the fact of their granting—both occurring either in anticipation of, or during the pendency of the suit—is one of the points that we hereafter more fully discuss.

Judge MORRIS, in the Circuit Court, did not consider the grants of patents to Boyden, especially under such circumstances, as of any controlling importance (R., p. 852).

The Court of Appeals, on the contrary, considered the action of the Patent Office as



FOLDOUTS TOO LARGE TO
BE FILMED

"In fact, a ruling that the Boyden device did not infringe Westinghouse's 'quick-action' Patent No. 360,070."

"That ruling takes rank here as the testimony of experts of the highest experience, skill and knowledge in mechanics" (Record, p. 879).

Here is a wide divergence of view.

There are two forms of the Boyden valve before the Court. One is the form described and illustrated in the Boyden Company's catalogue of 1889 (see Diagram opposite p. 44 of Record).

This form is substantially that illustrated in the Boyden Patent No. 481,134.

The second form of Boyden valve is that illustrated in the Boyden Company's catalogue of 1891 (see Diagram from said Catalogue opposite p. 36, which is here inserted).

This form is substantially that illustrated in the Boyden Patent No. 481,135.

The valve of Boyden Patent No. 481,136 needs no special consideration, as there is no proof, in the present case, that the Boyden Company ever manufactured or sold that form.

The defendants' valves of their 1889 catalogue and of their 1891 catalogue are so similar as not to need much separate discussion. The 1891 form is the latest form and the form most largely sold, and it will, therefore, be principally discussed.

Conclusions arrived at in regard to it will be applicable to the valve of 1889.

Considering, now, the defendants' valve of 1891, what features do we find that it embodies, and what is its mode of operation?

Its construction and mode of operation are fully described by complainant's witness, Mr. Newbury (Record, pp. 29-43).

Such mode of operation may be briefly summarized, as follows:

When the structure is to be prepared for action—that is, when the brakes are in a "release position"—the position is shown in the figured diagram (20) "Release Position" (Rec., p. 36).^{*} In this posi-

^{*}The parts which, we contend, correspond to those of Westinghouse are here similarly colored.

tion, air under pressure, entering from the train-pipe, passes the edge of the triple-valve piston 29, through the small grooves at the lower and upper edges of said piston (or under check valve 26), and passes slowly into and through the passage A to the auxiliary reservoir until said reservoir is filled. The triple-valve mechanism is then in a position to act, when desired, for applying the brakes. The brake-cylinder is exhausted or opened to the atmosphere through the exhaust-passage G.

When the brakes are to be applied gradually or slowly, so as to make a "service" stop, air-pressure in the train-pipe is reduced slightly (say from three to five pounds), and the reduction of pressure on the right side of the piston 29 (such piston being subject to the full pressure of the auxiliary reservoir air on the left side, through a passage A) causes the triple-valve piston 29 to move to an intermediate position shown in diagram (21) "Service Application."

Such preliminary movement or traverse of the piston pulls the parts rigidly attached to said piston towards the right of the figure. One of those parts is the stem slide-valve 18, through which is the aperture, *i, k, j*,

In this position of the stem slide-valve, the opening, *i*, of this passage is upon one side of the part 22, through which the stem has been pulled, and the opposite opening of said passage, *j*, is on the opposite side of said part 22.

Auxiliary reservoir pressure, being operative through the passage A, on the left side of the piston, and through the aperture B, into the chamber C, holds the part 22 in a closed position against its seat, while such auxiliary reservoir air passes through the passage *i, j, k*, and from thence through the passage *h*, to the brake-cylinder.

By this action of the parts, a gradual or "service" application of the brakes, by auxiliary reservoir pressure only, takes place. The part 22 has not moved.

Now, if "quick-action" is required, a different set of operations is involved.

In that case, the travelling-piston 29, instead of only making a "preliminary" traverse to the intermediate position, as shown in

*Auxiliary
Reservoir*

Brake C



*Auxiliary
Reservoir*



(21), makes a full, or "further", traverse to the extreme right hand position, as shown in (22) (facing Rec., p. 37).

This is caused by the sudden lowering of the pressure in the train pipe on the right side of the piston to a considerable extent, say fifteen or twenty pounds.

The effect of this "further traverse" of the piston, acting quickly and with considerable force, as the result of the larger reduction of train-pipe pressure, is that the collar *m* upon the stem 18 pulls the part or valve 22 off its seat and *opens a comparatively large passage to the brake cylinder*, under the valve 22, and around the stem 18. The comparatively small amount of air pressure in the chamber C, being allowed to quickly diffuse itself through the large aperture to the brake cylinder, and being only slowly replenished from the auxiliary reservoir through the restricted aperture B, the result is that the pressure of train-pipe air, through the large passage F, in the centre of the triple-valve piston, throws open widely the large check valve 26, *and train-pipe air rushes directly to the brake cylinder*, through the large passage F, past the check valve 26 into the chamber C, under the valve 22, and thence to the brake-cylinder.

Auxiliary reservoir air also flows in, but much more slowly, owing to the fact that it must pass the restricted passage B, which is large enough to admit an adequate supply for service applications, when only the passage *i j k* is opened, but which is *inadequate* to maintain the pressure of air in the chamber C when the valve 22 is pulled clear away from its seat, by the further or extreme traverse of the piston.

These several operations will, perhaps, be more clearly perceived at a glance by inspection of diagram 14 on opposite page.

In this, all unessential details are omitted, and the valves for release, service and quick-action work are colored green, black and red, respectively, as in the Westinghouse diagram 10 (opposite p. 22).

So far, the experts on both sides agree as to the operation of the defendants' structure.

The defendants' experts, however, insist that there is an additional operation which *may sometimes* take place, which is this :

They say that, while the stem slide valve 18, with its aperture and ports *i, j, k*, is in fact used for graduating stops, or "service" stops, in many (if not in most) cases, yet that it is possible to move the triple-valve piston 29 to its extreme right-hand position *so slowly*, and therefore to open the valve 22 or pull it off its seat *so gradually* that the pressure in the chamber C will be reduced so slightly and slowly that the train-pipe air will not have sufficient preponderance to force or throw open the check valve 26, and hence that no train-pipe air will be admitted directly to the brake cylinder.

In such a case, they say, the brake cylinder will be filled by auxiliary reservoir air only, *even although* the piston 29 makes its further or extreme traverse, and even although the valve 22 is opened thereby.

Theoretically, this is possible, but the complainants prove—and the proof is uncontradicted—that this action can *never take place* until the brake cylinder, and the passages beyond the valve 22, *have been so nearly filled with air pressure* from the auxiliary reservoir *before* the valve 22 is pulled off its seat, that there is no substantial reduction of pressure in the chamber C as the result of opening said valve 22, and *no real use in then opening the valve 22 at all*.

On this point the evidence is decisive (see Newbury, R., p. 169, fol. 256 ; Barnes, R., p. 391 ; Westinghouse, R., p. 293, Qs. 431-435) ; and their statements are in accord with what an intelligent consideration of the operation of the structure shows *must be the case*.

Briefly, the fact is, as more fully demonstrated by Barnes experiments (Rec., p. 391), that in *service use*—that is, *without quick action*—the Boyden valve 22 cannot be opened at all to admit auxiliary reservoir pressure to the brake cylinder, until *after* ninety to ninety-five per cent. of such pressure shall have been charged through the port *i j k* ; and this being done, it *made no practical difference whether valve 22 was open or closed*, pressures being equalized at about ninety-eight per cent.

And this demonstrates that valve 22 does not and cannot perform any material portion of main-valve work—that is, the admission of *auxiliary reservoir* pressure to the brake cylinder. That work is done by the port *i j k*; and the valve 22 is (for all *practical* purposes) solely a “quick-action” valve.

Even Boyden cannot say that, as a fact, the valve 22 can *ever* be lifted from its seat without admitting train-pipe air direct to the brake cylinder, and thereby effecting a quick application of the brakes, except in the case of a *single valve* operating *by itself*, when tested in the defendants’ shops (Boyden, Record, p. 578, x-Q. 214).

And all he is willing to assert is that the valve 22 *may* be lifted for this slow admission of auxiliary reservoir air without causing “quick action” by the admission of train-pipe air, if the operation be performed *by “a careful engineer”* (Boyden, R., p. 579, x-Q. 216).

He goes further. He admits that he cannot say that, even with such an engineer, this manipulation could be effected, except on a comparatively *short* train, with a small and unknown number of cars (perhaps not beyond the tenth car, and certainly not beyond the thirtieth) (Record, Boyden, p. 579, x-Q. 215).

He admits further that the circular of the Boyden Co., issued in 1889, *makes no mention* of any such possible operation, although it *fully describes the others* (Rec., p. 575, x-Q. 199), and he also admits that the engineers’ valve, advertised by that company for use to apply brakes, has no running position which would result in such manipulation (p. 578, x-Qs. 210, 211). The assertion that the valve so operates is thus clearly shown to have been an afterthought.

Inasmuch as “quick action” of brakes, by the admission of train-pipe air direct to the brake cylinders, is particularly useful only on *long* trains of, say, from 30 to 50 cars, and as it is not even pretended that the Boyden valves can be so manipulated as to admit auxiliary reservoir air only, except on trains of 30 cars *or less*, and perhaps not on trains of more than *one* car, that particular juggling with the valve need not, we think, be taken into serious consideration.

The question is: What is the *ordinary operation* of the apparatus, when manipulated and acting in the ordinary manner, and on long trains of from 30 to 50 cars?

If, under such circumstances, the parts operate in a given way it is of little importance what they can be made to do by special manipulations on *short* trains, upon which their peculiar functions are not needed.

The operation of the Boyden valve, therefore, on long trains, and *under all ordinary circumstances of manipulation*, is as follows, and *only* as follows :

For "service" applications, or for graduating the speed of the train, the triple-valve piston 29 makes a preliminary traverse to the right, under the influence of a slight reduction of train-pipe pressure, and in so doing pulls out the stem slide valve 18 (black), so as to uncover its port *i*, opening the passage for auxiliary reservoir air only through port *i*, passage *k* and port *j* to the brake cylinder.

During this operation, the valve 22 (red) is not moved from its seat, and cannot move, because, until the brake cylinder is substantially full, and, therefore, until the brakes are, at least, *nearly fully* applied, the pressure upon its right-hand side, which holds it to its seat, will be greater than that upon its left-hand side, which would tend to force it from its seat.

Now, when "quick action" is required, the operation will be as follows :

A sudden great reduction of pressure in the train pipe on the right-hand side of the piston 29 will cause the said piston to make its complete or further traverse, and, as a result of that traverse, the valve 22 (*red*) will be pulled off its seat by the contact of the collar *m* with its under side. The air in the chamber C being then suddenly allowed to diffuse itself from the chamber C into the large brake cylinder, its *pressure* will be reduced, and the check valve 26 will open by pressure of train-pipe air, and train-pipe air will rush directly past the check valve, past the valve 22 and through the large openings thus formed into the brake cylinder.

The brake cylinder will be much more rapidly filled than when auxiliary-reservoir air *only* is supplied through its restricted passage, and the brakes will be applied with "quick action."

In the Boyden Patents will be found a description which accords with that given above.

Boyden Patent No. 481,135 says (R., p. 809) :

"This invention relates to the construction of valves for automatic air brakes, and has for its object to provide for admitting air-pressure to the brake cylinder from both the train-brake pipe and the auxiliary reservoir, thereby effecting a more powerful and also a quicker application of each brake and at the same time so quickly reducing the air pressure in the train-brake pipe adjacent to the said valves that all the brakes of a train will be applied at nearly the same time."

And, again, on page 812 :

"To apply the brakes by graduation a slight reduction of the pressure in the train pipe moves the piston 29 and its attached parts until the shoulder *q* on the stem 18 comes against the main valve 22 (the main valve remaining immovable on its seat, owing to the air pressure in the valve chamber C, holding it thereon). This movement closes the release valve port *i* and draws the graduating stem 18 through the main valve 22 sufficiently far to expose the graduating port *k*¹ in the valve stem to the air pressure in the valve chamber C. The air then passes from the auxiliary reservoir by way of the large passage A and small passage B into the valve chamber C, and then through the graduating port *k*¹, passage *o*, and opening *k* in the valve stem and the passage *g* to the brake cylinder, where it affects the partial application of the brakes. This operation, which does not open the main valve port, is due to the fact that the restricted communication B, through which the auxiliary reservoir air enters the valve chamber C, is larger than the graduating port *k*¹, and, therefore, the pressure in the valve chamber is kept substantially equal to that in the auxiliary reservoir. This retention of the pressure in the valve chamber when graduating holds the main valve 22 and the check valve 26 seated on their respective ports."

And again (R., p. 813) :

"The brakes may be applied *fully* in two ways : first, by the auxiliary reservoir pressure alone, and, second, by the auxiliary reservoir pressure in conjunction with the train-pipe pressure. The first mode is used when an ordinary gradual stop is required, such as at a station. The second mode is used when an emergency stop is required, such as upon the occurrence of an accident. To apply the brakes fully for an ordinary stop, a limited amount of train-pipe air is continuously discharged from the engineer's valve, which reduces the pressure in the train pipe and slowly moves the piston 29 to the left and opens the main valve 22 sufficient to practically maintain the same air pressure on both sides of the said piston.

The piston and the said valve will be retained in the position just mentioned, or the position will slightly vibrate back and forward, causing the valve 22 to repeatedly unseat and seat by the discharge of the auxiliary reservoir air (through the valve chamber C to the brake cylinder), being about equal to the continuous discharge of air from the train pipe at the engineer's valve. Under these conditions the pressure in the brake cylinder, valve chamber C and auxiliary reservoir will equalize, and thus the ordinary function of the triple valve in applying the brakes fully by the auxiliary reservoir pressure alone is accomplished."

The latter part of this description, as we have already shown, is one of a merely theoretical operation.

The patent then describes its "quick-action" function, as follows (R., p. 814):

"To apply the brakes of a train quickly and with full power for an emergency stop, the engineer's valve will be moved to close communication between the storage tank on the locomotive and train-pipe and open the latter to the atmosphere and effect a sudden reduction of pressure of from ten to twenty pounds in the train-pipe. The effect of this sudden diminution of pressure in the train-pipe is immediately manifested at the triple-valve mechanism on the first car, causing the valve-piston 29 to be moved by the higher pressure of auxiliary reservoir air quickly to its full outward position, thus moving the main valve 22 and opening the main port *c*, so that the air pressure contained in the valve-chamber C may exhaust freely into the brake-cylinder. The supply of air from auxiliary reservoir to the valve-chamber is conducted through the restricted or small passage B. * * * The exhaustion of pressure from the valve-chamber C or the great reduction of pressure therein following the sudden opening of the main port *c* brings said air pressure below that existing in train-pipe, whereupon the check-valve 26 will be immediately unseated by said train-pipe pressure, and train-pipe air will then pass directly into the brake-cylinder J, thus effecting the quick application of the brakes and also further reduction of pressure in the train-pipe that will be sufficient to accelerate the action of the valve mechanism on the cars following."

This patent of Boyden's No. 481,135 (as well as the other patents of Boyden's No. 481,134 and 481,136) seek, it is true, to disguise the really essential facts of the operation of the Boyden valve, and to differentiate its operation from that of the Westinghouse Patent No. 360,070, by including (as above quoted) a description of the intermediate kind of brake application, which the patent calls "full service application," and in which kind of application the

patent asserts that the structure will operate to apply the brakes fully by the *slow opening* of the valve 22, an opening *so* slow that that valve will admit only auxiliary reservoir air.

This alleged intermediate operation of the Boyden valve has, as we have seen, no real foundation in actual use. It is never realized in practice, as expressly proved by a practical engineer, Mr. Kidder, who used the Boyden valves in the practical running of trains (Record, pp. 425-428); also by Mr. Nellis, a practical machinist and locomotive engineer (Rec., 433-435), who took part in the same practical test; and there is not only no proof that it actually took place at all in practical use, but Boyden himself admits that he cannot say that it *could ever* take place in use *on long trains*.

This description of this alleged intermediate and theoretical mode of operation is apparently introduced into the Boyden Patents for the purpose of giving color to the propriety of calling the valve 22 "the main valve" of the triple valve.

Boyden had doubtless noticed that, in the Westinghouse Patent No. 360,070, Westinghouse speaks of the valve 41, which admits train pipe air directly to the brake cylinder, as a valve which is auxiliary to, and independent of, the main valve of the triple valve, and he apparently conceived the idea of *calling* the valve 22 (which certainly does perform the "quick-action" work in his valve), "the main valve," and by assigning to it a function in admitting auxiliary reservoir air to the brake cylinder, in a *possible* service application, he laid a foundation, as he supposed, for *asserting*, in his description, that he has dispensed with an *auxiliary*, or supplementary, valve for doing quick action work, and that he was performing that service by a valve which he *calls* the "*main valve*."

By so doing, he hoped to avoid the phraseology of the Westinghouse claims, and, so, the charge of infringement.

The difficulty with the contention is, that the *real* "main valve" of the Boyden structure, and of his patent, is the *sliding stem valve 18, with its port i, passage k and opening j, through which auxiliary*

reservoir air is admitted for all practical purposes, and under all practical circumstances—especially on long trains.

The “main valve” of a triple valve is the valve which is *relied upon* for the admission of *auxiliary reservoir air* to the brake cylinder in the operation of service braking.

It is that function which the stem slide valve 18 *always* performs in all *long* trains, and *for all practical purposes* even on short trains.

That valve 18, with passages *i, k, j*, is the true “main valve,” and that fact is not to be disguised, because Boyden has incorrectly *called* the valve 22 “the main valve,” when it is *really* the “emergency” valve, and never does operate otherwise on long trains at all; nor upon any trains, except as the result of some careful manipulation, after the brakes have been nearly fully applied, and when there is no use whatever of its operating.

The Defendants' Valve Infringes the 1st, 2d and 4th Claims of the Westinghouse Patent No. 360,070.

If the construction and mode of operation of the “quick-action” valve of the triple valve structure of the Westinghouse Patent No. 360,070, have been clearly explained and fully apprehended, and if the construction and mode of operation of the Boyden valve have also been clearly explained and apprehended, there will then be little difficulty in examining the question of infringement, especially in view of the fact that the invention of Westinghouse is concededly one of a “primary” character, and

“is conspicuously one of those pioneer inventions which entitle the proprietor to a liberal construction from the Courts in considering the claim.”

(Court of Appeals Decision, Record, p. 880.)

We first consider the second claim.

(1) The Second Claim is infringed.

The phraseology is as follows:

“2. In a brake mechanism the combination of a main air pipe, an auxiliary reservoir, a brake cylinder and a triple valve having a

piston whose preliminary traverse admits air from the auxiliary reservoir to the brake cylinder, and which by a further traverse admits air directly from the main air pipe to the brake cylinder, substantially as set forth."

Unless this claim be "fatally defective" (as held by the Court of Appeals, the error of which position we hereafter hope to show), it is clearly applicable to defendants' apparatus.

Defendants' apparatus is admittedly a brake mechanism possessing a double capacity; viz., (1) for service use, and (2) for emergency or "quick action" use.

It contains a combination of a main air (train) pipe, an auxiliary reservoir, a brake cylinder, a triple valve having a piston, and this piston *has*, and is designed to have, a *double traverse*.

Its shorter or "preliminary" traverse operates directly to shift the sliding stem valve 18, with its ports and passages *i j k* (black), so as to admit "auxiliary-reservoir" air *only* to the brake cylinder; and its longer or "further" traverse (when operating by a *sudden* and *comparatively large* reduction of pressure) unquestionably admits air from the main air (train) pipe to the brake cylinder. It does this by pulling the valve 22 (red) off its seat and opening a large passage to the brake cylinder, and by suddenly producing such large differential pressures on the opposite sides of the check valve 26, that it flies open and admits train-pipe air directly to the brake cylinder.

(2) *Even if the defendants' "quick-action" valve has an additional duty, that does not help defendants.*

Suppose it to be true, as alleged by the defendants, that, by *careful* and *slow* manipulation, the piston of the triple valve could be moved so slowly, and by such slight and gradual reductions of pressure, that the valve 22 *may* be pulled off its seat without allowing the introduction of any train-pipe air, or without allowing the opening of the check valve 26 for that purpose, does the capacity for this slow manipulation, by means of a very moderate and gradual reduction of air pressure, change the fact that, *with a quick and large reduction* of pressure, and a complete or "further traverse" of the piston *thereby* produced, the direct admission of train-pipe air

to the brake cylinder, and the resulting "quick action" of the valves, is inevitable?

Does the fact that the defendants have so constructed their valve that it not only performs *all* the operations of the Westinghouse valve, but is, *also*, capable, by very careful manipulation, of partially performing an additional function, make any difference?

We have already shown that this alleged additional function is of no real value. The apparatus cannot be manipulated so as to open the valve 22 to admit auxiliary-reservoir air, *without admitting direct train-pipe air, except after the brake cylinders have been substantially filled with auxiliary-reservoir air, and hence the brakes have already been applied.*

We have also shown that this possible manipulation cannot, in fact, take place in connection with the use of the apparatus on long trains, for which alone the apparatus is expressly designed; and that the alleged additional mode of operation is, therefore, an unimportant and idle one, under the very conditions in which the defendants' structure, as a whole, is designed to be operative and useful.

Admitting then, that, theoretically, the defendants' valve is capable of an *additional* mode of operation to those specifically described and claimed in the Westinghouse Patent in suit, does that relieve the defendants of the charge of infringement?

This has been so frequently denied by recognized text writers, and authoritatively decided to the contrary by courts, that a few references are all that is required to disprove the contention.

"One thing, to be equivalent to another, must perform the same functions as that other. If it performs the same function, *the fact that it also performs another function is immaterial to any question of infringement.*"

Walker on Patents, Sec. 352.

"Again, equivalence is not affected by the fact that the new element performs in the invention some function in addition to the old."

Robinson on Patents, Sec. 251.

"If the question was between a single patented device, conceded to be new, and a device claimed to infringe, because an equivalent, the alleged infringer could not protect himself by showing

that, although his device was an equivalent of the patented device in all its functions, and in its construction and mode of operation, yet, by other or additional features, it possessed other and further useful functions. Such a device would, perhaps, be an improvement upon the patented device, but must be, nevertheless, deemed an appropriation of the former."

Sarven vs. Hall, 9 Blatch., 524-538.

"The only difference worthy of notice is, that its forward edge or side is, in the Clipper, elongated and curved upward, in the more perfect form of a shoe. On that difference I have already observed at some length, and will not here repeat my observations. I may add, however, that it partakes rather of the character of difference in degree than difference in function, although, in the complainant's machine, this function of the device is imperfectly performed, and, in some situations, might not be effective. Besides, this Court, on a former occasion (*Sarven vs. Hall*, 9 Blatchf. C. C. R., 524), held that a device is not less an equivalent of another merely because, superadded to all the functions of such other, it may perform another office. Still less does it fail to be the equivalent of another, because, besides all the functions of such other, it performs some of the offices more effectively or better, so long as it performs them in substantially the same way, and uses substantially the same means."

Wheeler vs. The Clipper Mower and Reaper Company, 10 Blatch., 181-195.

"If not exactly the same thing, in mechanical construction, it is, clearly, a mechanical substitute for it. It may perform some other functions, but this does not prevent it from being an infringement."

Norton et al. vs. California Automatic Can Co. et al., 45 Fed. Rep., 637, 638.

"The mechanism of Gordon is simply reversed in Palm's device. In the former the upper sharpened edges of the cleats on the wedge arms, and the lifting of the casing cause the wedge arms to catch the well wall, and thus secure the starting point in a self-supporting casing, viz., a stationary base; in the latter, the spring and gravity, or jarring, cause the same result, though from an opposite starting point. In both, increased pressure on the wedge cone aids and finishes the work. *That the additional function of the wedge arms helping sustain the casing appears in the Palm device does not make it any less an infringement.* It is still Gordon's device inverted, plus the added function of the sustaining aid of the wedge arms. As such, it is our duty to decree it an infringement." * * *

Musseth vs. Palm, 51 Fed. Rep., 824, 826.

"If the mode of effecting the continued mixture adopted by defendant should be deemed a new and useful improvement, they might perhaps have a patent for that particular device without being entitled to use Tilghman's process, on which it is but an improvement.

* * * * *

"The introduction of an improvement gives no title to use the primary invention upon which the improvement is based."

Tilghman vs. Proctor, 162 U. S., 707.

"If he be the original inventor of the device or machine called the 'divider,' he will have a right to treat as infringers all who make dividers operating on the same principle, and performing the same functions by analogous means or equivalent combinations, *even though the infringing machine may be an improvement of the original, and patentable as such.*"

McCormick vs. Talcott, 20 How., 402.

See, also,

Blake vs. Robertson, 94 U. S., 728-733.

Cochrane vs. Deener, 94 U. S., 780-786, 787.

Marsh vs. Seymour, 97 U. S., 349-359.

(3) *The fact that defendants selected a different form of triple valve, to which to add the "Quick-Action" element, does not help them.*

Nor, again, can the defendant escape the charge of infringement solely because his apparatus is very different in form or appearance from that of Westinghouse?

The contrary of this has been so definitely stated by this Court as to leave nothing further to be advanced on the subject.

In *Machine Co. vs. Murphy* (97 U. S., 120), this Court said:

"Similarities or differences are not to be judged by the names of things, but the machines, or their several devices or elements, must be examined in the light of what they do, or what office or function they perform and how they perform it. One thing is substantially the same as another if it performs substantially the same function or office in the same way to attain the same result; and things are substantially different when they perform different duties or in a different way or produce a different result. For the same reason similarities or differences are not determined by the mere fact that things are apparently the same or are of a different shape or form; but the true test of similarity or difference is the same in regard to shape or form as in regard to names. In both cases regard must be had to the mode of operation or the way in which the parts work, and the result as well as the means by which the result is attained."

Let us apply these principles to a comparison of the Westinghouse structure with that of the defendants.

The illustrated form of the Westinghouse structure is that of a

triple valve of the form shown in the Westinghouse prior Patent No. 220,556, but provided with certain additional structural features which give it the capacity for "quick action."

The defendants' structure is also a triple-valve apparatus, modified by the addition of certain structural features, which confer upon it the same additional function.

Of course, the particular form of the triple, which is used as the basis of "quick-action" modification, is unimportant.

Westinghouse has (as already seen) expressly guarded, in the preamble to his claims (Record, p. 788), against any limitation to his specific form of triple valve upon which his improvements are engrafted.

And, if the Westinghouse Patent had not contained this express statement, the law would imply the same or an equivalent recital.

A few illustrative diagrams will, perhaps, better than mere description by words, illustrate the fact that, for all essential purposes of the Westinghouse invention, the defendants' apparatus is a mere change of form.*

Let us see how this is, by a renewed study of *the exact mode of operation* of the Westinghouse structure :

Opposite the next page is diagram 10 (already used at p. 22), illustrating the particular type of triple valve adapted for "quick action" which is illustrated in the patent in suit, No. 360,070.

Unnecessary parts are omitted, and only those features which are here in controversy are shown.

Colors are used, so as to place clearly before the eye the several parts, so that they may be carried in mind. The different air pressures, and the directions of air pressure, are shown by appropriately colored lines in the different figures. The figures show the several parts of the valve in its three characteristic positions.

* These illustrative diagrams are not a part of the record ; they are simply a means of conveying to the Court our idea of the character of the changes made by defendants, as being simpler and more easily understood than words alone.

The first figure shows the apparatus in the "Release" Position, or "Brakes Off."

The triple-valve piston occupies its extreme left-hand position. The "main valve" (colored black) closes the access from the auxiliary reservoir to brake cylinder, and leaves open (as shown in green) the valve aperture from the brake cylinder to the open air.

The opening from the train pipe is closed by the "quick-action" or *emergency* valve (colored red), and by the check valve located below.

The check valve is kept closed by a spring until the difference in air pressure upon its two sides is sufficient to open the valve against said spring.

As the emergency valve (red) prevents any excessive pressure on top of the check valve in the Release position, the check valve is kept closed.

An interior auxiliary poppet valve of Patent No. 220,556 (colored yellow), to be hereafter explained (pp. 69-78), is closed.

The second Figure, on the same page, illustrates the change of position of some of the parts when the piston takes a "preliminary," or half traverse to the right, under the influence of a small reduction of train-pipe pressure.

Under such circumstances the "main valve" (black) has been shifted so as to bring one of its apertures opposite the port to the brake cylinder.

The poppet valve (yellow) has been also shown pulled to the left. Auxiliary reservoir air (shown by a red line and red arrow) now enters the brake-cylinder, and the brakes are applied by auxiliary-reservoir air only ("Service" or "Graduating" work), through the comparatively small passageways in and controlled by the "main valve."

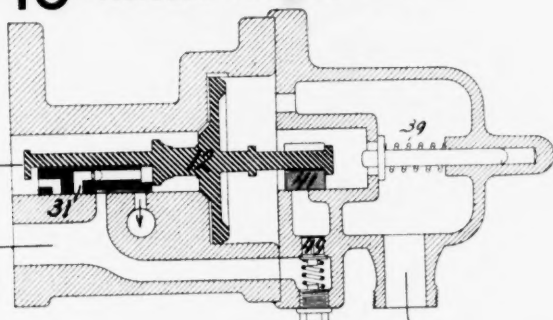
The shifting of the "main valve" has also closed the exit from the brake cylinder to the atmosphere (colored green), so that the air charged into the brake cylinder cannot escape.

The emergency valve (red) still remains closed. The piston has not traversed sufficiently far to move it. As there is no preponder-

To Auxiliary
Reservoir.

10—Release (Brakes Off).

To Brake
Cylinder.

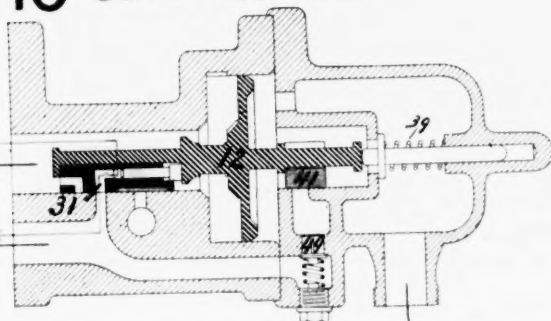


To Train Pipe.

To Auxiliary
Reservoir.

10—Service Application.

To Brake
Cylinder.

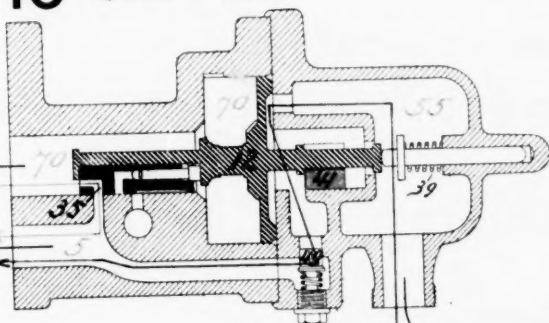


To Train Pipe.

To Auxiliary
Reservoir.

10—Quick Action.

To Brake
Cylinder.



To Train Pipe.



ating difference of pressure on opposite sides of the check-valve, the check-valve also remains closed, and there is no access of train-pipe air to the brake cylinder.

The third figure on the same page, shows the position of the parts when the extreme or "further traverse" of the triple-valve piston takes place, under the sudden and large reduction of train-pipe pressure. In this case, the release-port from the brake cylinder to the atmosphere (green) still remains closed, and the brake cylinders may be filled. The main valve (black) has been shifted further to the right and therefore still admits auxiliary reservoir air (shown by the red line and arrow); *but slowly*, because of the small size of the aperture.

The sudden lowering of the train-pipe pressure, and the quick and extreme or "further traverse" of the piston, have, however, pushed the emergency (red) valve off its seat. *The check valve has now been subjected to a marked difference of pressure on opposite sides.*

The train-pipe pressure, although reduced to 55 pounds from its initial force, is still vastly in excess of the pressure *slowly percolating from the auxiliary-reservoir through its restricted aperture*, and expanding in the large spaces below and beyond the check-valve. Consequently, the check-valve *now opens*, and train-pipe air (shown by the blue line and arrow) rushes directly through the comparatively large passages and apertures to brake cylinder, the brake cylinder is, therefore, *quickly filled* and the brakes are applied, with "quick action." *

* In this, and in all other diagrams, the *red* numerals indicate the differing ("differential") air pressures which exist for a moment ("momentarily"), when the "quick-action" valve is opened, and which differing pressures, then existing on opposite sides of the *check valve*, cause it to open and admit TRAIN PIPE air.

Now, to see what changes may be made in the illustrated form of the Westinghouse apparatus of Patent No. 360,070, let us examine a structure in which one feature, wholly unnecessary for "quick action" (which is the main feature in controversy here) is eliminated.

This feature, which we are now to consider as eliminated, is the supplementary poppet valve (yellow).

That valve is, as will be fully explained, merely a delicate valve for *closing* and *reopening* the aperture through the main valve, *after* the latter has once been moved into a position which permits the brakes to be applied, *without requiring the main valve to again move*.

It performs no function in connection with "quick action," and may, therefore, be left out of account *for the present*.

On the opposite page is shown (diagram 1) a triple-valve contrivance, adapted for *quick action* in the manner described and claimed in Patent No. 360,070, but with this delicate "poppet" valve (yellow) omitted.

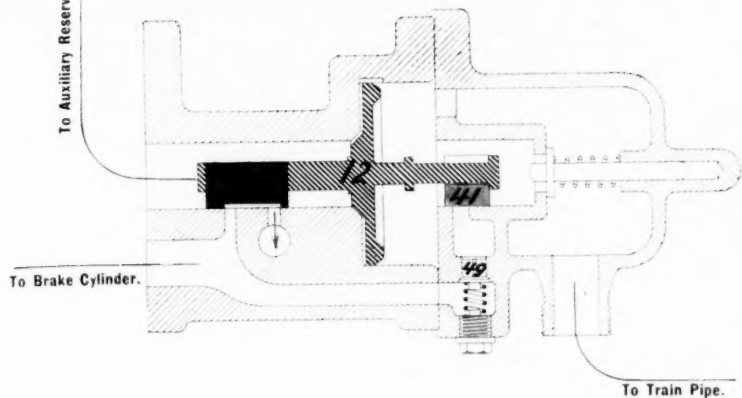
It will be immediately perceived that all the essential operative "quick-action" features are present in this modified valve, although the delicate poppet valve (yellow) is omitted.

The first figure represents the parts in the initial or "release" position, with the brakes off. The triple-valve piston is in its extreme left-hand position. The main valve permits the opening (green) from brake cylinder to atmosphere to exist. The access from the auxiliary reservoir to brake cylinder is closed by the "main valve" (black). All access from train pipe to brake cylinder is closed by the emergency valve (red).

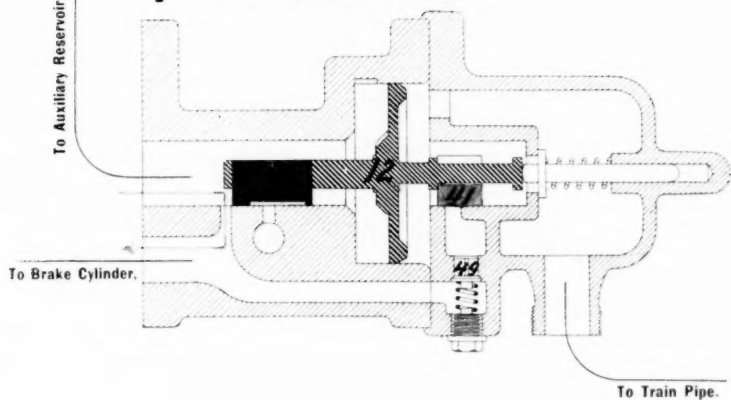
The second figure, on the same page, illustrates the position of the parts in "service" work.

The main valve (black) has been shifted to close the aperture (green) from brake cylinder to the air. The restricted aperture from auxiliary reservoir to brake cylinder is opened, and auxiliary reservoir air (red line and red arrow) is filling the brake cylinders. The access from train pipe to brake cylinder is closed by the emergency (red) valve and by the check valve.

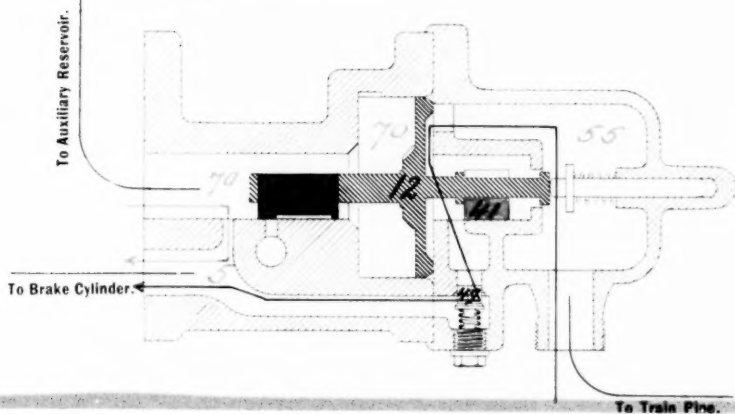
1—Release (Brakes Off).



1—Service Application.



1—Quick Action.



The third figure represents the same apparatus in "quick-action" position.

The piston has been shifted to the right, and makes its extreme or "further" traverse. The emergency valve (red) has been pushed off its seat. The *difference of pressure* on opposite sides of the check valve now causes the check valve to open. Train pipe air (indicated by blue line and blue arrow) flows direct to the brake cylinder, and is accompanied by a smaller amount of auxiliary reservoir air (indicated by red line and red arrow).

No one will dispute that the invention of Patent No. 360,070 is clearly illustrated in the apparatus thus shown.

Now, let us proceed a step further.

It is obviously not important that the emergency valve (red) should be located on the *right* side of the piston, or that it should be *pushed* off its seat.

If the mere location of the principal passages be changed, the emergency valve (red) may be located on the *left* side of the piston.

The diagram opposite, marked 2, illustrates these changes in the location of the parts, being otherwise the same as diagram 1.

A few moments' inspection of these figures shows that all of the operative parts are really the same, the change being a mere change of location, without affecting the functions of those parts.

In "2-Release", the parts are in a released position, and both the main valve (black) and the emergency valve (red) are closed.

In figure "2-Service", the piston has taken its "preliminary" traverse. The main valve (black) has been shifted so as to close the release port from brake cylinder to atmosphere (green), and the port from auxiliary reservoir to brake cylinder (red line and red arrow) is being opened.

The emergency valve (red) remains closed.

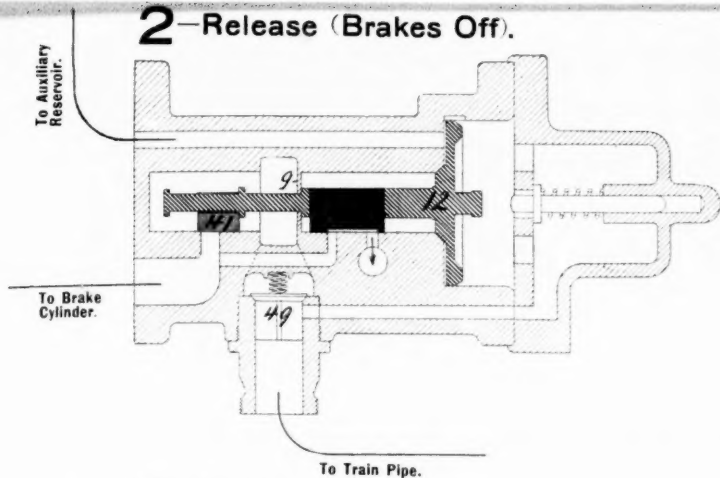
The third figure shows the "quick action" of the brakes.

The piston has made its extreme traverse. The main valve (black) and the emergency valve (red) have both been *pulled* off their respective ports. Auxiliary-reservoir air (red line and red arrow) enters through its *restricted* aperture slowly. Train-pipe air (blue line and blue arrow) asserts a preponderating pressure on the check valve, which consequently opens, and train-pipe air rushes through the large aperture to the brake cylinder.*

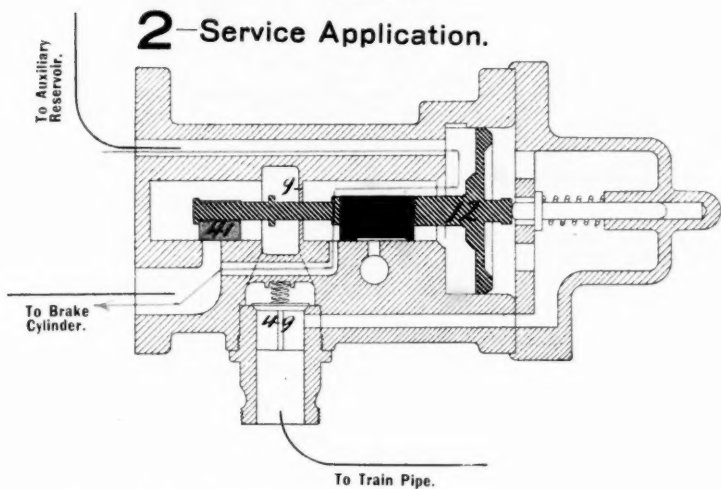
We see by these diagrams that the position of the emergency valve

* All forms of "quick-action" triple valves necessarily involve *some form* of a wall or partition between auxiliary reservoir air and the direct passage for train-pipe air. It will be observed, by inspection of diagram 2, that the change in the location of the "emergency" or "quick-action" valve 41, from the one side of the piston (*opposite* to the side upon which the main valve is situated, as in diagram 1) to the other side of the piston (the *same* side as that of the main valve, as in diagram 2), involves the use of a "partition" (9), and the "restricted" passage for auxiliary-reservoir air must be *through* it or *around* it; otherwise, the continual presence

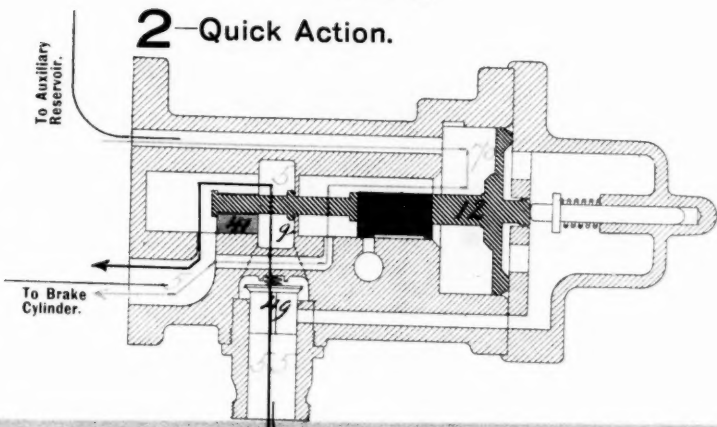
2-Release (Brakes Off).



2-Service Application.



2-Quick Action.



(red), on one side of the piston or the other, is immaterial to the invention of Patent No. 360,070. The position may be better in one case than in the other or not, but there is no change of function, nor of the way in which the functions are performed. The change involves a mere change in the form and location of the passages and of the valves.

But let us proceed a step further, and consider whether the *form* of the emergency valve (red) itself is material.

In the two prior diagrams, the emergency valve (red) has been shown as a "slide valve."

Is a "slide valve" essential to the contrivance?

Diagram 3, on the opposite page, tends to show that it is not.

In this diagram, the only substantial change that has been made is the change in the emergency valve (red), from a "slide valve" to a "plug" or "poppet" valve. Said valve no longer *slides* from its seat; it is *lifted* from its seat. There has been a change in the arrangement and location of the air passages, caused by the change in the form of valve and the way in which it seats itself, but there is no change of substance.

The parts operate, in all essential particulars, in precisely the same way, as will be evident upon a brief examination of the respective figures; and cause both "service" application and "quick-action" application in the same way as when a "slide" emergency valve is used.

If the changes in form and location of the parts, illustrated in diagrams 1, 2 and 3, are not such as to substantially differentiate the structures therein shown from the Westinghouse invention of Patent No. 360,070, claims 1, 2 and 4 (as we may easily see), then neither (as we shall show) are the changes of form and arrangement embodied in the defendants' valve.

of auxiliary-reservoir air, at higher pressure, in the passage containing the "quick-action" valve, would prevent the flow of train-pipe air into and through this passage when the "quick-action" valve is opened. Boyden's "partition," hereafter considered, is, therefore, a mere incident to the location of the "emergency" valve in his structure, viz., upon the opposite side of the piston from that of the Westinghouse. The partition is numbered 9, wherever it appears in this form.

In considering the question of infringement, especially in connection with the first and fourth claims, let us consider the contention of the defendant, that all that they have done is to adapt an old form of triple valve to quick-action work, *without providing* it with any auxiliary "quick-action" valve.

Bear in mind, still, that the Westinghouse Patent is not limited to a particular form of triple-valve structure.

The quick-action invention may, as he contends, be engrafted upon, or caused to be embodied in, *any* of the various known forms of triple-valve structures.

Now, the defendants contend that what they started with, when Boyden proposed to modify a triple-valve structure so as to make it capable of "quick action," was an old form of "triple," and one devised by Westinghouse himself.

The Westinghouse Patent No. 141,685, dated August 12, 1873, is concededly the *form* of triple valve upon which Boyden worked, in constructing the valve complained of.

See Church's evidence, Record, pp. 623, 624.

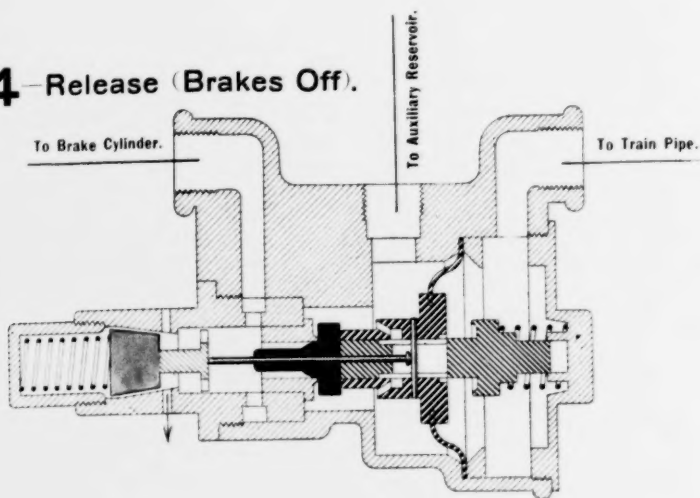
What Boyden really did, as we now hope to show, was to modify the structure of Patent No. 141,685 (1st) by altering the "main valve" of Patent No. 141,685 in shape; (2d) by providing an "additional valve," which should act to admit train-pipe air direct to the brake cylinder; (3d) by changing the location and direction of the air passages so as to admit train-pipe air.

That this was the real character of the changes will, we think, be apparent from an inspection of the following diagrams, in which each of these changes are shown as separately introduced, so that their real character will be better understood.*

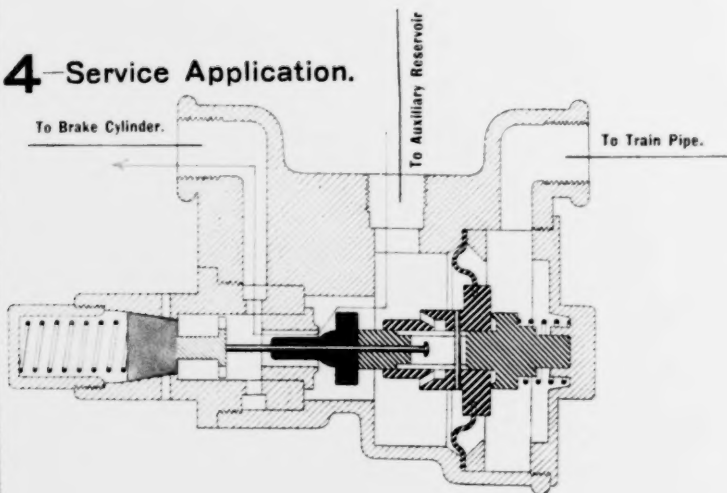
The Boyden valve in controversy is represented by diagram 14, opposite page 41, and this diagram represents the three characteristic positions of the parts of the valve, viz., the "release" or "brakes-off" position, the "service" position (for ad-

* It is to be understood, of course, that these diagrams, also, are not a part of the record, but are illustrations which perhaps more easily convey to the mind a realization of what the defendants really did than would a description in mere words.

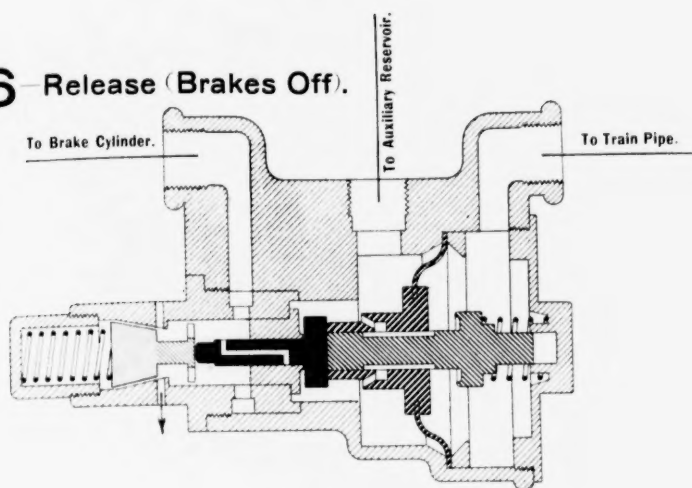
4—Release (Brakes Off).



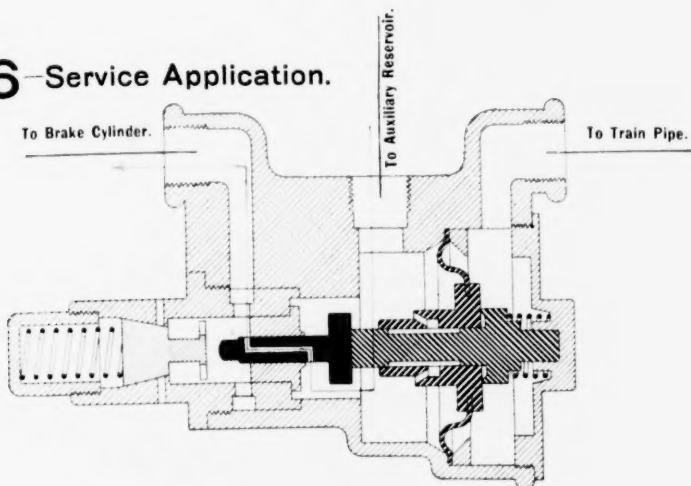
4—Service Application.



6—Release (Brakes Off).



6—Service Application.





mitting auxiliary reservoir air), and the "quick-action" position (for admitting, also, direct train-pipe air).

In diagram 4, opposite the preceding page, will be found the plain triple-valve of Patent No. 141,685 (with unnecessary details omitted).

As this valve was capable of admitting only auxiliary reservoir air to the brake cylinders, two positions only are shown, viz., 4—"release" position and 4—"service application" position, in which auxiliary reservoir air is admitted either partially and gradually, or fully, according to the extent to, and length of time during, which the "main valve" (black) is pulled off its seat.

Starting with these figures, illustrating the valve of Patent No. 141,685, the *real* nature of the changes that Boyden has made, to convert this valve into a "quick-action" valve, will be easily comprehended, if they be considered one by one.*

These changes may be enumerated as follows :

FIRST. The defendants have changed the form of the "main valve" (black) from a "plug" form of valve to that of a "stem slide valve." This change is illustrated in diagram 6, on the opposite page, which shows two positions of the valve of Patent 141,685,¹ modified merely by altering the "plug" form of "main valve" into a "sliding stem valve" and changing the ports in it,

* It is to be noted, in passing, that Patent No. 141,685 shows that it was not a new expedient of Boyden's to cause the *release* of air from the brake cylinder to the atmosphere to be effected by a valve (green) *separate* from the "main-valve" (black).

In some of the old forms of Westinghouse triple, as, for instance, in the form shown in Patent No. 220,556, and in the form shown in Patent No. 168,359 or 172,064, the "main-valve," itself, is provided with an aperture which enables it to do the work of "releasing;" but in the earlier patent of Westinghouse, No. 141,685, the release-valve (green) is separate from the "main-valve" (black), and is located at the left side of the structure.

This is the position and arrangement of the parts embodied in the defendants' valve, and is adverted to simply to show that the change of position of the "release" valve is not one which affects the present controversy.

A similar change of position of the "release" valve used in connection with the "quick-action" valve of Patent No. 360,070 (the patent in suit), without any change of function, is illustrated in diagram 12, opposite, behind diagram 6.

for the admission of auxiliary reservoir air to brake cylinder, so that they become operative by being drawn out of the bushing or casing which surrounds said "main valve" (black).

If the aperture through the valve be *partly* uncovered, there will be a *partial* admission of air, just as when the plug main-valve of diagram 4 is only slightly lifted.

It is clear that, so far, there has been no *substantial* change from the structure of Patent No. 141,685. It does exactly what it did before, but does it by means of the movement of stem "slide" valve *through* its bushing, instead of by the *withdrawal* of the "plug" valve from its bushing or seat.

SECOND. What next may be done to the structure of Patent No. 141,685 ?

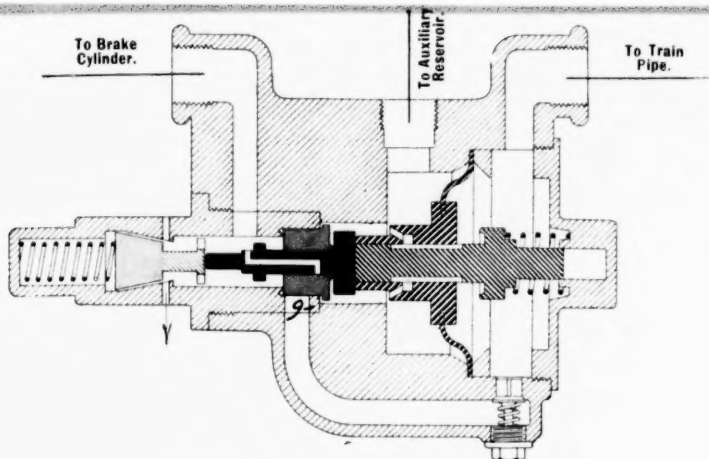
A NEW VALVE may be added, which opens when the piston (or diaphragm) makes its EXTREME stroke. This is shown in diagram 7, on the opposite page.

Here, as will be seen, the bushing, or casing, of the main-valve (black) of diagram 6 has been converted into a *separate valve* (of the "plug" variety), and the extreme or "further traverse" of the diaphragm, or piston, has been caused to pull the said plug-valve off its seat, by means of a collar behind it (see lower figure, "Quick-Action"), and to thus open a *larger passage* than before to the brake cylinder.

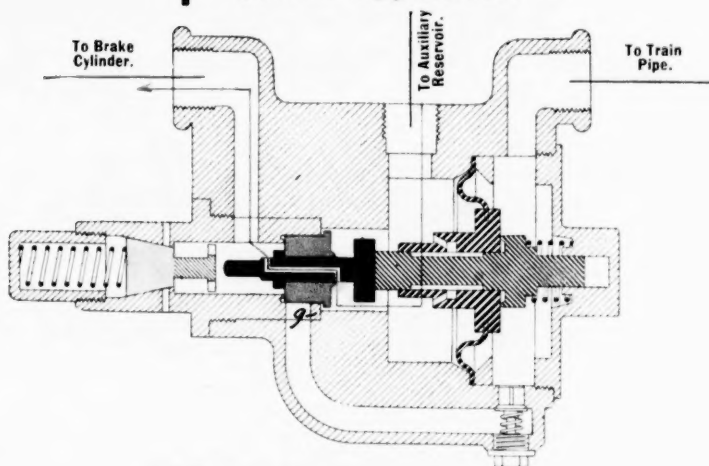
A short, or "preliminary," traverse of the diaphragm (or piston) does *not* unseat the new valve (see second figure), but allows the apparatus to work as it did in the form shown in diagram 6.

THIRD. This alteration of the structure, so as to provide a new valve, has been accompanied by a *change of air-passages*, so that the NEW VALVE will be operative, *when* opened, *to admit train-pipe air* to the brake cylinder.

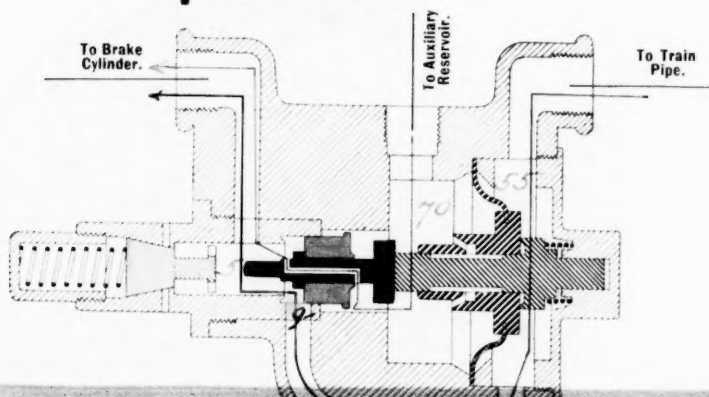
Train-pipe air (indicated by the blue line and blue arrow) then passes directly from the train-pipe, through the check-valve and under the left side of the emergency-valve (red), to the brake cylinder.



7—Service Application.



7—Quick Action.





A partition, at 9, prevents any interference with the flow of the train-pipe air through the new passage thus opened.

The difference of air-pressures, on opposite sides of the check-valve, causes said check-valve to open (just as in the Westinghouse structure of Patent 360,070). The passage for auxiliary reservoir air is so small, that, while such air passes in sufficient quantities for *service* application of the brakes (or for graduating), it cannot pass in sufficient quantity to maintain equal pressure on both sides of the check-valve, *when* the new emergency-valve (red) is opened, and, hence, the check-valve *then* opens and admits train-pipe air.

Diagram 8, on opposite page, shows the partition 9 merely moved further to the right, and, as this position would cut off the flow of auxiliary-reservoir air for "service applications," a small aperture must now be made through it, as shown.

NOTE. Another way of looking at Boyden's changes in the valve of Patent 141,685, is that he has *changed* the plug "main valve" of that patent into an "Emergency" or "Quick-Action" valve, by providing that it can be opened *only* by the *extreme traverse* of the piston, and by *altering the air passages*, through the insertion of a partition, so that the opening of the valve will admit *train-pipe air* to the brake cylinder; and then, by forming *another valve* out of the *stem* of the original main valve, to admit auxiliary-reservoir air to the brake cylinder for "Service" work. But this comes to the same thing.

This change in the character of the air passages (caused by changes in the location of the partition and making in it a small aperture) is not materially different from the arrangement of air passages shown in the patent in suit, No. 360,070, as will, we think, be apparent from an inspection of the preceding diagrams.

Diagram 9 shows the valve of diagram 8, modified in form, by simply making the emergency (red) valve a *lift* valve (instead of a *plug* valve), and by arranging the air passage from train pipe to brake cylinder so as to go *through* the triple-valve piston, or diaphragm, instead of *around* it. THIS MAKES THE DEFENDANTS' VALVE.

Can any one doubt, after inspecting these diagrams, that the Boyden structure is really the structure of Patent No. 360,070, *under a mere change of form*.

Let us, then, again enumerate these changes, understanding that a mere change of form is immaterial, so far as any departure from the essential features of Patent No. 360,070 is concerned.

FIRST. The release valve (green) has been altered in position so that the "release" is no longer effected by the movement of the main valve (black), as in Patent No. 360,070. It is now effected by the movement of a separate valve (green) at the left-hand of the structure, as illustrated in Westinghouse Patent No. 141,685.

SECOND. The "main valve" (black) for admitting auxiliary reservoir air to the brake cylinder and applying the brakes has been changed in form from a "plug" valve to a "sliding stem valve" (see diagram 6).

Clearly this is an immaterial change, so far as Patent No. 360,070 is concerned.

THIRD. A new valve has been made (diagrams 7 and 8) around, and supplementary to, the stem slide valve, which opens a larger passage of the brake cylinder. This valve opens only on the extreme traverse of the piston.



1

FOURTH. A new air passage (diagrams 7 and 8) has been provided, direct from train pipe to brake cylinder, which is normally closed (during "service" application of the brakes) by a spring check valve, but which is opened (when "quick action" of the brakes is desired) by reason of the fact that train-pipe pressure, on one side of said check valve, preponderates over the slowly admitted pressure from the auxiliary reservoir, upon the other side.

This new passage, which is closed by the check valve, is, in the Boyden valve, located in the centre of the triple-valve piston or diaphragm, whereas in the Westinghouse Patent No. 360,070 the new passage is located *around the edge* or side of the triple-valve piston or diaphragm.

This difference in location of the new air passage is clearly immaterial, as is seen by a comparison of the diagram 9 (which represents the valve of Patent No. 141,685, modified so as to provide a direct passage from train pipe to brake cylinder *through the centre* of the triple-valve diaphragm or piston, as in the Boyden valve), with the diagram 8, which represents the new passage *around the* triple-valve diaphragm or piston.

FIFTH. The *new* valve, which controls or governs the *new* air passage, is one of the "lift-valve" variety instead of one of the "plug valve" variety.

This difference is clearly immaterial, as is seen by a comparison of diagram 8 with diagram 9, and simply results from the change of location of the new air passage, from the side of the triple-valve piston (or diaphragm) to the centre.

The allegation that Boyden has done something substantially new by inserting a *partition*, having a small aperture in it, to restrict the flow of auxiliary reservoir air, for the purpose of obtaining such a difference in pressure on opposite sides of the quick-action check valve as to result in the opening of said check valve, when quick action is desired, is wholly unfounded as a matter of fact.

It is true that the restricted aperture is *in a different place* in the Boyden valve from what it is in the valve of Westinghouse Patent No. 360,070, but this is simply due to the location of the emer-

gency valve and of the emergency air passage, and not to any difference in the plan or mode of operation.

The Westinghouse Patent itself expressly refers to the restriction of the opening for the admission of auxiliary-reservoir air, and to the effect of such restriction upon quick action, in the following words (Westinghouse Patent No. 360,070, Record, p. 788) :

"The feed opening for the admission of air from auxiliary reservoir to the brake cylinder is *purposely* made of comparatively small diameter, it having been determined by experimenting that the initial application of the brakes should not be made with maximum force, and this opening may be made of such size as to apply the brakes exactly in accord with the requirements of the most efficient working."

That the differential pressures, on opposite sides of the quick-action check valve, are the same in the Boyden structure as in the Westinghouse structure of Patent No. 360,070, and that this difference in pressure is due to the restriction of the air passage from auxiliary reservoir to brake cylinder, is fully explained by the complainant's witnesses.

(See Newbury, Record, p. 163, Q. 205 ; Barnes, p. 195, Q. 230 ; Barnes, p. 373, Q. 672 ; p. 374, fol. 580 ; p. 377, fols. 584-5 ; Westinghouse, p. 287, Q. 417.)

As Mr. Westinghouse says (R., p. 288),

"The presence of restricted air passages, for the purpose of creating momentary differential air pressures, is required for the same purpose in the defendants' structures as in that shown in Patent 360,070, and it does not exist in any different degree in any of these structures."

(4) *The First and Fourth Claims are infringed.*

If we have now correctly explained the defendants' valve and its mode of operation, and have correctly indicated the changes which the defendants have introduced in developing the old Westinghouse triple of Patent No. 141,685 into a "quick-action" valve, we shall be prepared to consider the other claims of Westinghouse Patent No. 360,070 ; viz., the first and fourth.

Those claims are in the following words :

"1. In a brake mechanism the combination of a main air-pipe, an auxiliary reservoir, a brake cylinder, a triple valve, and an aux-

iliary valve device, actuated by the piston of the triple valve and independent of the main valve thereof, for admitting air in the application of the brake directly from the main air-pipe to the brake cylinder, substantially as set forth."

"4. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, a valve working within the piston stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake cylinder and to the atmosphere, respectively, and an *auxiliary valve actuated by the piston stem and controlling communication between passages leading to connections with a main air pipe and with the brake cylinder, respectively, substantially as set forth.*"

We have italicized those parts of the claims which are in controversy.

Clearly, the defendants' valves have all of the features of both of these claims. They have "an auxiliary valve device actuated by the piston of the triple valve" (first claim), or "actuated by the piston-stem" (fourth claim).

It makes no difference that in one case the triple-valve piston *pushes* this auxiliary valve off its seat and opens the new passage to brake cylinder (as in Patent No. 360,070), nor that in the other it *pulls* such a valve off its seat and opens a similar passage (as in the Boyden structure).

Nor does it make any difference that, in Patent No. 360,070, the "stem," which opens the auxiliary valve, is on the right side of the piston, while, in the Boyden structure, it is on the left.

The auxiliary-valve device is also as "independent" of the *real* "main valve" in the Boyden structure, as it is in the Westinghouse structure.

In both cases, the auxiliary valve is moved by the triple-valve piston and the stem attached thereto, and in each case there is an "independent," quick-action valve, *i. e., independent*, in the sense that there is a "main valve" which does the "service work" of admitting auxiliary reservoir air to the brake cylinders when service work only is required, and another valve which does "quick-action" work by admitting train-pipe air to the brake cylinders when quick action is required.

Even if it were true, as the defendants contend, that, under certain special circumstances, and by special and careful manipulation, the valve 22 (red) of the Boyden structure can *also* (in *some* cases, and by "careful" manipulation) be made to admit only auxiliary-reservoir air to the brake cylinders, yet it is none the less true that such valve is *principally useful* for "quick action," and is "independent" of the sliding stem valve, which is *mainly*, and to the extent of from 90 to 95 per cent., relied upon for "service" work.

Can the defendants escape the charge of infringement if they have a valve which performs "quick action" work, and which is clearly "auxiliary" to, and "independent" of, another and separate valve, which performs at least some (and, as we prove, the principal, if not all of the substantial, part of the "main valve" work), merely because, by some special manipulation, and under some special circumstances, that auxiliary and independent valve can also be made to do some "main valve" work?

The defendants' auxiliary or "quick-action" valve is clearly independent of *one* "main valve," and this, as we show, and as the Circuit Court below held, the *principal* one.

The Court of Appeals were clearly in error (*Rec.*, p. 881, *foot*) when they said that the *principal* function of valve 22 is to do "main-valve" work (*i. e.*, to admit auxiliary reservoir air to the brake cylinder), and that its "quick-action" work is only incidental. *The contrary is true.*

Differences between valves, more marked than those here involved, were disposed of by this Court as immaterial, in *Consolidated Safety Valve Co. vs. Crosby*, 113 U. S., 157.

In that case, the Court said :

"There is one structural difference between the two valves, which is now to be mentioned. In the Richardson valve, *all* the steam which escapes into the open air escapes from the huddling-chamber, through a stricture which is smaller than the aperture at the ground joint. In defendants' valve, the valve proper has two ground joints, one at the inner periphery of the *annulus*, and the other at its outer periphery, and *only a part of* the steam, namely, that which passes through one of the ground joints, passes through the huddling-chamber, and then through the stricture; the other part of the steam passing directly from the boiler into the air through the other ground

joint. But all of that part of the steam which passes into the huddling-chamber and under the extended surface, passes through the construction at the extremity of such chamber, in both valves; the difference being only one of degree, but with the same mode of operation."

* * * * *

"When the ideas necessary to success are made known, and a structure, embodying those ideas, is given to the world, it is easy for the skillful mechanic to vary the form by mechanism, which is equivalent, and is, therefore, in a case of this kind, an infringement."

The defendants' stem slide valve is not the sensitive graduating valve of Patent 220,556.

It remains to consider one contention urgently pressed by the defendant, and which had the qualified approval of the Circuit Court (Judge MORRIS) (Record, p. 844), and, possibly, of the Circuit Court of Appeals (Record, p. 882).

That contention is that the stem slide valve 18, with its apertures, *i, j, k*, of the Boyden structure, is essentially the sensitive poppet valve, inside the "main valve," of the Westinghouse Patent No. 220,556, and hence (as alleged) that the valve 22 of the Boyden structure is only the "main valve" (under a change of form) of the Westinghouse Patent No. 220,556, and prior Westinghouse patents.

The Circuit Court (MORRIS, J.) said on this subject, as follows (p. 844):

"It is probably true that in the Boyden mechanism, the stem valve *i, j, k*, which I take to be the equivalent of the sensitive graduating valve shown in the Westinghouse Patent No. 220,556, October 14, 1879, is so constructed that it may do, *and probably in most cases does do, the work of ordinary breaking*; that is to say that by two or three successive applications of pressure through that smaller and more sensitive valve the brake cylinder is filled and the main valve 22 becomes non-essential, or, if lifted off its seat, is moved very gently; but valve 22 will, if the engineer uses his brake valve *carefully*, do the work of a main valve, as is demonstrated, I think, by the experiments in which the sensitive graduating valve *i j k* was plugged up. So I take it that defendant's valve *i j k* must be held to be the sensitive graduating valve usual in triple-valve devices since the Westinghouse Patent No. 220,556; and the defendant's valve 22 must be considered to be the main valve, and that in defendant's mechanism he has been able, by an ingenious arrangement,

restricting the admission of auxiliary-reservoir air to the triple-valve chamber, to cause the main valve to do both main-valve work, when needed, and to do quick-action work when needed.

"As, by the explicit terms of Claims 1 and 4, Westinghouse has restricted himself, as to those claims, to an auxiliary valve, independent of the triple valve, I hold that the defendant does not infringe those claims.

The Court of Appeals dealt with the subject more briefly (R., p. 882), in the following words :

"We think the Circuit Court was correct in its view that the poppet valve 22 of Boyden is the original main valve of 220,556."

Are those views correct ?

We note the exact position taken by the Circuit Court, and, apparently, approved by the Circuit Court of Appeals.

It was conceded that the stem-valve *i j k* "is so constructed that "it may do, and probably *in most cases* DOES DO, the work of preliminary braking"—*i. e.*, "service" work—and hence that, generally, the so-called "main valve 22 becomes non-essential" *for that purpose*, and that it is only in case the engineer uses his brake valve "carefully" that the valve 22 *can ever* do "main-valve" work.

That it so worked *at all* (even under the exceptional circumstances stated), Judge MORRIS, and apparently the Circuit Court of Appeals, thought was demonstrated by working the Boyden valve with the apertures *i j k* *plugged up*—that is, by rendering *inoperative* the very valve features which, it was conceded, did "main-valve" work "in most cases." The other valve *could then* be made to do "main-valve" work.

But this so-called demonstration, by which the defendants convinced the courts, was very misleading as to the real character of the valves.

The character of a valve (say, the valve 22) is determined by what it does in the structure as actually organized—not by what it does when that organization is materially altered. In the defendants' structure there are obviously two valves; one, the valve *i, j, k*, which, as is conceded by the Courts, does "main valve" work "in

most cases," and, as is apparently conceded, in *all* cases, *unless* the engineer be "careful."

The other is clearly the valve which is *always relied upon* to do "quick-action" or emergency work whenever such work is required.

Is this latter valve 22 any the less a "quick-action" emergency valve, auxiliary to, and independent of, the "main valve" of the triple, because, in a few cases, and by a careful manipulation, it may also be made to supplement the "main valve" work, ordinarily done by the other valve?

If the defendant uses two valves, and one of them be an "emergency valve" and independent of the other, does it make any difference that the emergency valve, while independent of one main valve, for *emergency* work, can be made, on short trains or in exceptional cases, also to do supplemental main valve work?

The Courts below were misled by not giving careful attention to the wording of the Westinghouse claims. They thought that those claims required "an auxiliary valve independent of the triple valve" (Record, p. 485), and as defendants' "emergency" valve was in the case of the triple, they supposed that it could not be the emergency valve of the patent.

What the claims did really require were: An auxiliary valve "actuated by the piston of the triple valve and *independent of the main valve* thereof" (First Claim).

Or, merely,

"An auxiliary valve actuated by the piston-stem" (Fourth Claim).

If the defendants' valve 22 was, as is conceded, really an "auxiliary" valve, and actuated by the piston stem, and adapted for doing, and actually doing, "quick-action" work, as auxiliary to another valve which was relied upon "in most cases" for doing "main-valve" work, the substance of the fourth claim is clearly found.

And, if such auxiliary valve be independent of *even one* "main valve," especially of the one which does main-valve work "in most cases," we have also the substance of the first claim.

But Judge MORRIS and the Court of Appeals were mistaken in supposing that the stem valve *i j k* of the Boyden structure was the equivalent of the "sensitive graduating valve" of the Westinghouse Patent No. 220,556.

As this patent plays an important part in this case, and as its special feature was, in some respects, misapprehended both in the Circuit Court and in the Court of Appeals, a brief statement of its nature will be here attempted.

In this patent, illustrated in the accompanying figure (opposite page 75), which is taken therefrom (Rec., pp. 737-8), Westinghouse shows an air brake which takes power, for *all* conditions of use, from the auxiliary reservoir.

It did *not* use "train-pipe air" at all for the direct purpose of filling the brake cylinders and applying the brakes. The piston of the triple valve actuated a slide valve, known as the "main valve," whose principal office it was to admit air directly from the auxiliary reservoir to the brake cylinder.

A partial or slight traverse of the piston moved the slide or "main" valve a short distance, and caused it to uncover a small aperture leading to the brake cylinder.

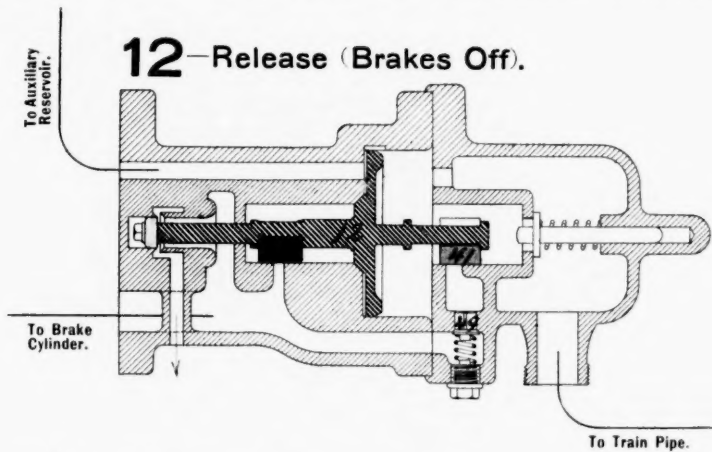
A long valve movement, or traverse, admitted a somewhat larger amount of auxiliary reservoir air. As already explained, these passages could not, for constructive reasons, be large.

The Circuit Court of Appeals (in the opinion now sought to be reviewed) spoke of this patent as follows (R., p. 874):

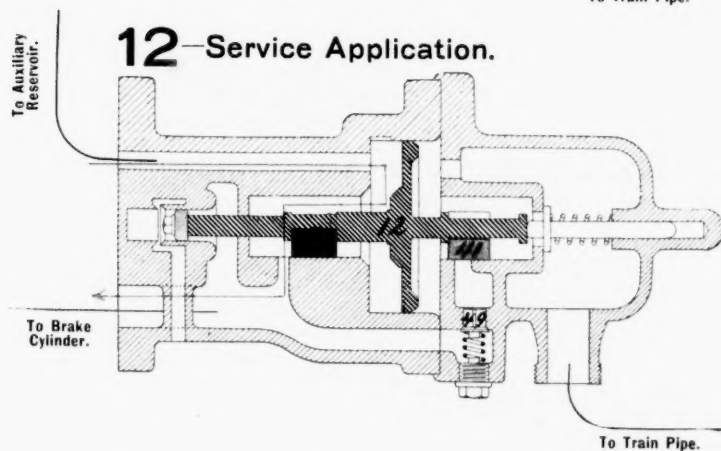
"A study of patent 220,556 will show that compressed air driven by the engineer into the train-pipe passed through the triple-valve of each car to its auxiliary reservoir; *that there was no vent for this train-pipe air into the brake-cylinder except through the auxiliary reservoir, and that this vent from the auxiliary reservoir to the brake-cylinder ordinarily occurred when the triple-valve piston had made but a partial movement or traverse in its chamber.* The text and diagram of 220,556 shows that *even a full or extreme traverse of the piston in its chamber would vent no other compressed air into the brake cylinders, except from the auxiliary reservoirs.*

"The device embraced in patent 220,556, valuable and efficient as it is and was for ordinary work on all trains, with the triple-valve piston in partial traverse, and for emergency work on short trains with the triple-valve piston in extreme traverse; *yet it failed to meet*

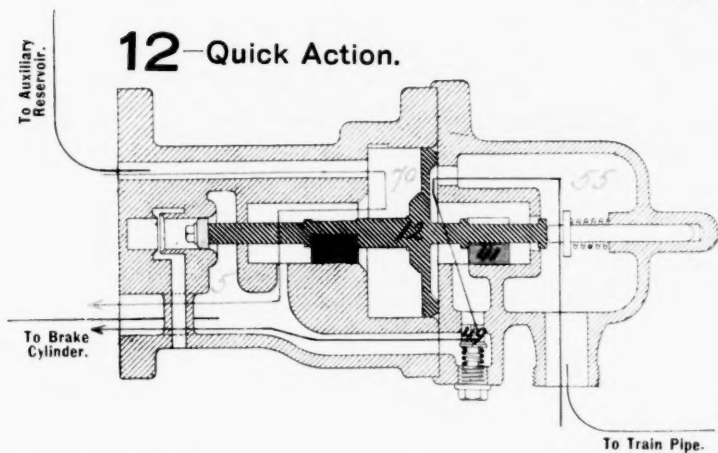
12—Release (Brakes Off).

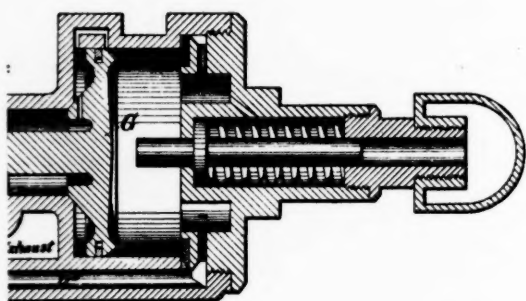


12—Service Application.

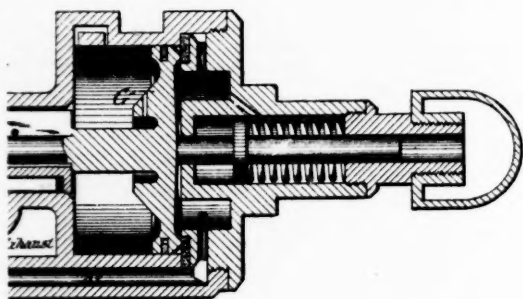


12—Quick Action.





②



③

the requirements of the service for emergency work on long trains of fifty large freight cars. For the latter work it was found insufficient in practice, the insufficiency consisting in not acting with sufficient promptitude. It is not for us to explain why the passage of compressed air exclusively from the auxiliary reservoirs to the brake cylinders was not sufficiently prompt on long freight trains. It is assumed in the briefs and testimony that the mechanism of this patent did not suffice for this work. It is admitted on both sides that while the mechanism of 220,556, though effective for the ordinary purposes of braking trains, such as stopping them at stations, slowing them in passing switches and other points requiring continuous movement, and checking them on descending grades, yet that it was not effective for abruptly stopping long trains in sudden emergencies.

But, in addition to the "main" slide valve for uncovering the openings from auxiliary reservoir to brake cylinder by different lengths of movement of the triple-valve piston, there was, in Patent No. 220,556, a subordinate feature of construction to insure greater accuracy.

It was this subordinate feature which was the subject matter of the claims of Patent No. 220,556.

The nature of this feature it is important to understand accurately, because the defendants have based their contention, that their steam valve *i j k* is the equivalent of this sensitive poppet valve, on, what we now hope to show to be, an erroneous view of its character.

A brief review of prior patents of Westinghouse will make this clear.

The admission of auxiliary reservoir air with different (although always LIMITED) rapidity, dependent upon the size of the opening uncovered, from auxiliary reservoir to brake cylinder, was old.

Thus, the Westinghouse Patent No. 168,359 (R., p. 752) describes a triple valve (shown on opposite page), the piston of which operates a slide valve H, which, according as the piston is moved to a greater or less extent, uncovers, to a greater or less extent, the passage *e* to the brake cylinder from auxiliary reservoir.

The patent says (R., p. 754) :

"The position of the piston G in its chamber *a* is regulated chiefly by variations of air pressure on its opposite sides, and, by lessening or increasing slightly the air pressure in *a* below the

piston, the position of the piston may be changed at pleasure, and with it, of course, the valve H."

"It will be observed that the valve H has at h^2 a length and breadth of face such that it may entirely cover the port e . Hence, the piston G may be brought down so that, while entirely closing the supply port s , it shall bring the valve H to a position where it shall uncover only a small part of the port e , or any desired part."

Patent of Westinghouse No. 141,685, dated August 12, 1873 (R., p. 736), illustrates (as already seen) another form of triple valve, in which the "main valve," for fully or partially opening communication from auxiliary reservoir to brake cylinder, is not of the "slide" valve variety, but is of the "poppet" or "plug" valve variety.

This patent "has more particular reference to the construction of devices by which a flow of compressed air from each auxiliary reservoir to its brake-cylinder can be regulated at pleasure, and thereby the brakes be applied with any desired degree of force less than the maximum."

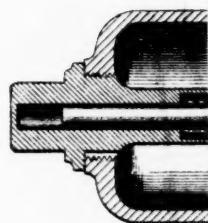
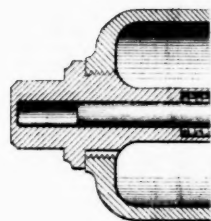
The patent shows a triple valve, operated by a "diaphragm," u (which is a well-known equivalent of a "piston").

The movement of the diaphragm, by reduction of pressure on the other side, causes a tapering "plug" valve o to open to a greater or less extent, according as the diaphragm is moved, communication to the brake-cylinder.

The patent says (R., p. 738) :

"The area of the opening through the port o^1 is regulated by the distance which the plug o is caused to move vertically upward. Hence, if the pressure be reduced but slightly at G^2 , the plug o will be raised but a short distance, and a small amount of compressed air or other fluid will be allowed to pass through and out at the port H^1 . * * * By the use of the taper plug o in the manner described, and by regulating, as can easily be done by the use of suitable cocks, the amount of pressure in the upper and lower parts of the chamber G^1 , it is easy to regulate the amount or density of the air which is permitted to flow through the port o^1 into the brake-cylinder, and consequently easy to regulate and adjust at all times the force with which the brakes are applied, and such force may be varied from the maximum power of the brakes down to the fractional part of a pound in excess of ordinary atmospheric pressure."

It will be perceived, therefore, that long prior to the date of Patent 220,556 Westinghouse had devised several forms of "main



valves " which, by the greater or less extent to which they uncovered an opening or openings into the brake-cylinder (depending upon the extent to which the triple-valve piston moved), regulated at will the amount of auxiliary reservoir air which was admitted to such cylinder.

In the *slide-valve* varieties of triple valve, however (such as those described in the Westinghouse Patent No. 168,359, and in the later patent of the same variety, dated January 11, 1876, No. 172,064 (R., p. 757), there was a lack of certainty in getting to any definite position desired, especially when *slight* variations of pressure only were employed. This was due to the fact that the main valve H was a *slide valve*, and was *subject to air pressure from above* which tended to hold it to its seat.

In Patent No. 220,556 Mr. Westinghouse dealt with the difficulty of operating *such a slide valve* by providing it with an interior auxiliary valve of the "poppet" variety, which could be moved more quickly and with much less pressure than the slide valve itself, and, hence, could be used to regulate the admission of air *after this main slide valve had been once shifted*, without requiring the *main valve* to again move at all.

Patent No. 220,556 (R., p. 762), says :

" It is important in such device that the valve (lettered H in said two patents and herein) which governs the flow of air or other fluid, shall move not only with great certainty to any desired position but also shall move with slight variations of pressure on the piston (lettered G), so that the application of the brakes with any desired power and their ready release may be quickly and easily effected at the pleasure of the engineer.

" To this end I combine with the said valve H, giving it a slight range of motion on its stem, an auxiliary valve operated by the same stem in such manner that a portion of the functions performed in said patents by the valve H may now be performed by such auxiliary valve, the latter moving with practically no resistance, and hence moving more quickly and with less pressure than the valve H itself. The same auxiliary valve is also designed for use under certain circumstances as a leakage valve."*

* These drawings (which are the same as those in the patent, Rec., p. 762) show the parts moving in reverse direction from the corresponding parts of the other drawings and diagrams presented. This will not produce confusion, if borne in mind.

Attention to the drawings and description of Patent No. 220,556 clearly shows the function and operation of this "auxiliary valve," which moves with practically no resistance, because, unlike the main valve, it is not a slide valve nor exposed on one side to air pressure, but is a "poppet."

It is to be noted, however, that this "poppet" valve cannot be used to open communication between auxiliary reservoir and brake cylinder, *until after* the "main" slide valve has moved.

The slide valve H must itself *first* move so as to cut off the opening from the brake cylinder to the open air or exhaust, and *also* so as to open, either partially or fully, communication from the auxiliary reservoir to brake cylinder.

But, *after* this communication has once been opened, either partially or fully, *then* the small interior auxiliary or poppet valve e^1 can be closed or reopened again, by slight movements of the piston, *without requiring any movement of the main valve H itself.*

The patent says (p. 764) :

"When now the valve H is thus shifted, so that the port s shall, to the extent of one-quarter or one-half its capacity, more or less, as is usual when less than a maximum braking force is desired, be thus brought into communication with the port C, and held there until the limited or desired amount of fluid pressure shall have passed into the brake cylinder, *the auxiliary valve e^1 becomes available as a quick and ready means of closing the supply port with certainty, without danger of opening the exhaust.* To this end, a very slight increase or excess of pressure below the piston G—much less, in fact, than is necessary to shift the valve H—will suffice to move the piston G and stem g far enough to close the valve e^1 on its seat e . All ports are thus closed by an almost instantaneous motion, and the brakes remain on with a force corresponding to the amount of pressure previously charged into the brake cylinder.

"In case a slight addition to the operative braking force is desired, either to compensate for loss by leakage or for any other reason, it may be secured by a slight downward motion of the piston G, such as will unseat the auxiliary valve e^1 . In this manner the graduating function may be more advantageously performed than heretofore."

And again (p. 765) :

"But with the explanation already given, it will be seen that the necessity of giving a back stroke to the valve H is wholly obviated, so far as relates to closing the ports and holding in the brake-

cylinder any predetermined or limited amount of fluid pressure, or to increase such pressure at pleasure, *since after the slide-valve H has been brought to the desired position*, as set forth, a slight motion imparted to the piston G, and much less than would be necessary to start the valve H, will suffice to seat and unseat the auxiliary valve e^1 , and so hold or retain in the brake cylinder any desired pressure previously charged therein, or permit the increase thereof at pleasure."

The function, therefore, of the auxiliary "poppet" valve e^1 , *in the slide valve H*, for the purpose of remedying its lack of sensitiveness and its excessive friction, will now, we think, be clearly understood. This auxiliary valve has no function in *initially*, or *without movement* of the "main" valve, opening access from auxiliary reservoir to brake cylinder.

Although it is unseated as soon as the piston G commences to move, yet it admits no air to the brake cylinder, until the slide valve H itself has been moved into the position which uncovers the port s^1 leading to the brake cylinder.

After that has once been done, then this auxiliary poppet valve can be used to close the access to the brake cylinder, without again shifting the slide valve H, or to re-open that communication, without such shifting.

It will thus be seen that the addition to the prior art in air brakes, which was made by Patent No. 220,556, was supplementing a main *slide valve* by an interior poppet valve.

The "sensitive graduating valve" of said patent was a "poppet" valve, working inside of the main slide valve, and there used, because *that kind of slide valve* was slow when delicate action was required. This poppet valve was brought into operation, *only and solely, after* the main slide valve had been shifted to open communication to the brake cylinder.

Now, there is no such construction in the Boyden apparatus, and no need of any such construction.

In the operation of the Boyden structure, the stem slide valve *i, j, k*, must move *first* and, *generally*, is the *only* valve that moves in "service" work.

It is that valve, and that alone, which initially moves to open, and does open, communication from the auxiliary reservoir to brake cylinder.

The valve 22, which surrounds the valve $i j k$, is *not* the true "Main Valve", because it does *not* move *first*, and can not move *at all* (to admit *auxiliary* reservoir air) *until after* the brake cylinders have been substantially filled through the ports $i j k$.

To consider valve 22 of Boyden the equivalent of the *Main Slide Valve* of Westinghouse, and the sliding stem valve 18 of Boyden, with its port $i j k$, the equivalent of the supplementary poppet valve of Westinghouse, is a view which is the very reverse of the construction illustrated in the Westinghouse Patent No. 220,556.

In that patent, the main slide valve opens communication from the auxiliary reservoir to brake cylinder *first*, and it is *only after it has moved* that the interior sensitive poppet valve can be brought into operation at all; and its first movement must then be to close the passage to the brake cylinder—not to open it.

In the Boyden structure, on the contrary, the valve 22 does not move *at all*, until *after* the brake cylinder has been substantially filled with air admitted by the apertures $i j k$.

The Boyden structure has, therefore, no sensitive interior poppet valve for closing and reopening communication, after a main slide valve has been shifted (which is the *only* function of the *poppet* valve of Patent 220,556), because it has no need of any such valve.

The Westinghouse structure of Patent No. 220,556 needed an interior sensitive poppet valve, because its "main valve" was a slide valve, *with air pressure on one side*, holding it to its seat and producing friction. The Boyden slide valve is a stem slide valve, *having equal air pressures on all its sides*, and, consequently, it moves freely.

The valve 22 of the Boyden structure is not the equivalent of the "main slide valve" of the Westinghouse Patent No. 220,556, because it is not relied upon to do main-valve work. The valve $i j k$ confessedly does such work "in most cases." The valve 22 does not do such work at all, except when the engineer is "careful,"

and, as already shown, if it can ever be done, it is only *possible* to do such work on the *front* cars of a long train.

Under such circumstances, it is not "*the main valve.*" It is a "*quick-action*" valve, auxiliary to, and independent of, the *real* "*main valve.*"

The Second Claim of Patent No. 360,070 is not "Fatally Defective."

The ruling on this point by the Circuit Court of Appeals is in the following words (Record, p. 880) :

"We think that when claim 2 of 360,070, in its language describing the action of that device, failed to describe any means by which the extreme traverse of the piston produced it, declaring merely that the piston, 'by a further traverse admits air directly from the main air pipe to the brake cylinder,' it was fatally defective, claiming only a result which is public property and not identifying the specific means (his own property), by which the result is achieved."

* * * * *

"But where the inventor falls so far short in his description as to claim only the result which his machine accomplishes, and omits an explicit definition of the *means* by which he does it, as in the case at bar, the Courts have another duty to perform, one which they owe to the public and to the worthy fraternity of inventors, and must decline to give him general rights where he is entitled only to special rights."

We submit that this ruling was entirely incorrect, in holding that Mr. Westinghouse had failed to adequately describe the means by which his result was accomplished.

It is not the office of a claim to *describe* the means. The specification does that. The claim is intended to "*specifically pointed out*" which of the many parts, necessarily *described* in giving a full explanation, are the *essential* features of the invention.

When the claim states, as it does, that the "preliminary traverse" of the piston "admits air from the auxiliary reservoir," and that the "further traverse" of the piston "admits air directly from the main air-pipe to the brake cylinder, substantially as set forth," it refers back to the specification; not, it is true, for a

slavish adoption of the *identical* instrumentalities there described but for an understanding of the essential and substantial features of the means therein illustrated.

"Substantially as described" means not *literally* as described, nor *identically* as described, but "substantially as specified in regard of the combination which is the subject of the claim."

Lake Shore Co. vs. Car Brake Co., 110 U. S., p. 229.

The specification describes, as already seen, certain features of the structure, which confer upon it its new capacity, under the control of the engineer, viz.: (1) the *double* traverse of the piston, (2) a passage, or way of access, directly from train pipe to brake cylinder, and (3) a valve which *controls* that passage.

These features are the essential features of the "means" by which the triple-valve piston, in its "further traverse," acts to perform its function of admitting air directly from the train pipe to brake cylinder.

The form and location of the passage and the shape of the valve and of the *intermediate* connections, are obviously non-essential, and may be varied within wide limits.

A patentee is not, as we understand it, bound, especially where his patent is one of a pioneer character, to limit himself to the mechanical connections by and through which the essential instrumentality, for producing motion, acts upon the instrumentalities for producing the specific result.

The fact that the claim omits to specify, and is not in fact confined to, the specifically illustrated and described connecting mechanism, by and through which the "further traverse" of the piston of the triple valve opens the valve which admits train-pipe pressure to the brake cylinder, does not make the claim "fatally defective;" nor does it enable an infringer, who varies the form of the connecting means, or substitutes other mechanical means, to escape infringement of the claim.

This has been so recently and unanimously ruled in this Court as to need no elaboration.

In *Deering vs. Winona Harvester Works*, 155 U. S. 286, 302, this Court said (p. 302) :

"Defendants further insist that the twentieth claim of this patent is invalid, by reason of the fact that, if the board *d*¹ be construed, as it evidently must, as a board pivoted to the butt adjuster, the combination is incomplete and inoperative, because the means by which it is held and controlled are not stated in the claim. * * * *Admitting that additional elements are necessary to render the device operative, it does not necessarily follow that the omission of these elements invalidates the claim, or that the precise elements described in the patent as rendering it operative must be read into the claim.* If Steward were, in fact, the first to invent the pivotal extension to a butt adjuster, he is entitled to a patent therefor, though the infringer may make use of other means than those employed by him to operate it (*Loom Co. vs. Higgins*, 105 U. S., 580, 584).

"In such case *any appropriate means* for making it operative will be understood. Otherwise, the infringer might take the most important part of a new invention, and, by changing the method of adapting it to the machine to which it is an improvement, avoid the charge of infringement.

"The invention of a needle with an eye near the point is the basis of all the sewing machines used, but the methods of operating such a needle are many, and if Howe had been obliged to make his own method a part of every claim in which the needle was an element, his patent would have been practically worthless. We think it sufficiently appears that Steward was the inventor of the pivoted extension described in the twentieth claim; that the claim is valid and was infringed by the defendants.

"We agree, however, that the defendants made use of a different method of adjusting this extension, which is neither the same invented by Steward nor a mechanical equivalent of the same. We hold, therefore, that the twenty-first claim was not infringed."

The same principles were applied by the Circuit Court of Appeals to a later and less important patent of Westinghouse for an air brake, No. 376,837, and those principles are still more applicable to the earlier and more important patent in suit.

In that case, the Court said (*Westinghouse vs. New York Air Brake Co.*, 63 F. R., pp. 962-969) :

"but the particular means by which this pressure was to be permitted to exert itself, whether continuously or only when a port should be opened, do not constitute an essential part of the invention. Means must necessarily be shown in the specifications, but the identical means or the special devices were not, in the language of *Machine Co. vs. Lancaster*, 129 U. S., 263; 9 Sup. Ct., 299, 'necessary constituents' of the invention, either in the specification or in

the claim. The skill and mechanical ingenuity of constructors of locomotives can, as will be seen hereafter in the examination of other patents and of the infringing devices, arrange different details of mechanical construction by means of pistons, valves, ports and springs, which, adopting the supplemental chamber system first conceived and embodied by the patentee, and a kindred but not precisely the same mechanical method for the movement of the piston, will accomplish the same result. * * * A Court would not be justified in adopting 'a narrow or astute construction' which would minimize the character of the invention, leave its real scope open to trespassers, and thus 'be fatal to the grant.'

In the very late case of *Taylor vs. Sawyer Spindle Co.*, 75 F. R., p. 310, a similar contention of the existence of a "fatal defect" was urged by the defendants, but the Circuit Court of Appeals for the Third Circuit (Judges ACHESON, WALES and GREEN) overruled such defense, saying :

"As a further defense it is contended that the claims sued on must be construed as containing the sleeve whirl, in which case they are not infringed, because the defendant does not use the latter, *or else they have no operative mechanism and are void.*"

"The law on this subject is too well settled to be open for discussion. A patentee is not required to claim the entire machine in each claim. Each of the claims of issue is for a complete combination of the spindle and its supporting tube and devices, and there was no necessity for expressing in terms the devices for revolving the spindle. Any appropriate means for operating it will be understood. The omission of the sleeve whirl *does not affect the validity of either one of the claims*, which belong to that class where reference may be made in the specification to supply in a claim what is plain to any one skilled in the art, is a necessary incident (*Reese Button Hole Co. vs. Globe Button Hole Co.*, 61 F. R., 970 ; *Deering vs. Harvester Works*, 155 U. S., 286)." (The italics are ours.)

Variance from Former Decisions Upholding this Claim.

Our first assignment of error relates to a conflict between this adjudication that Claim 2 is "fatally defective" in matter of form, and an adjudication made by the Court of Appeals in the Second Circuit.

This latter adjudication was made by a "*Per Curiam*" decision of the Court last named (69 Fed. Rep., 715), affirming the allowance of a preliminary injunction by Judge LACOMBE (65 Fed. Rep., 99) under the identical claims here in suit—claim 2 being one of the claims which Judge LACOMBE particularly discussed.* That the Court of Appeals in the Second Circuit adopted Judge LACOMBE's entire decision as to said claim 2, fully appears from the "*Per Curiam*" decision as rendered :

"We agree with the Court below that the defendant's apparatus "is an infringement of the first, *second* and fourth claims of Patent "No. 360,070, and *deem it unnecessary to add anything to the opinion "of Judge Lacombe*" (69 Fed. Rep., 715).

It goes without saying that the allowance of an injunction under any particular claim, and the affirmance thereof on appeal, necessarily implies that, in the view taken by the Court, as to such claim, it was not "fatally defective," nor even *materially* defective.

And the detrimental results, not only to the patentee, but also to the business interests of the railway public, which must follow such a conflict of adjudications, was not the least of the reasons why this Court is asked to review that which is believed to be the erroneous decision.

The Court of Appeals erred, in deciding that the grant of a patent to Boyden, subsequent to the patent in suit, was a decision by the Patent Office upon the question of infringement, and entitled to great respect.

What the Court said on this subject was as follows (Record, p. 879) :

"This question [of infringement] was presented necessarily to the Patent Office of the United States when Boyden applied for a

* Since this brief was written, the Circuit Court for the Southern District of New York (LACOMBE, J.) has rendered a decision on final hearing (*Westinghouse Co. vs. New York Co.*, Oct. 13, 1896), *reciting the variance* in the decisions of the two Circuit Courts of Appeals, but *upholding* the Second Claim as *valid* and infringed.

patent for the device under consideration. That office employs the best experts in mechanics which it can secure in this and other countries. Its examinations are, indeed, *ex parte* in form, but they are, nevertheless, conducted under hot and skilled contestation in every case of importance; and its decisions, though not conclusive, are entitled to great respect. That office, after full examination, awarded a patent to Boyden on the 16th day of August, 1892, for his quick-action improvement on the device of Patent 220,556, and that action by the office was, in effect, a ruling that the Boyden device did not infringe Westinghouse's quick-action Patent Number 360,070. That ruling takes rank here as the testimony of experts of the highest experience, skill and knowledge in mechanics. That ruling was subsequent to the issuing to Westinghouse of both the Patents Numbers 360,070 and 376,837, four years after the later patent, when the Patent Office had full knowledge of them."

It is not true, as matter of fact or matter of law, that the Patent Office "employs the best experts in mechanics which it can secure "in this and other countries."

Under a system of promotion, regulated by the rules of our civil-service system, ninety-six examiners are employed, at salaries ranging from \$1,400 to \$2,500 per annum (Rev. Stat., Sec. 440).

Whether such low salaries, under our civil-service system, can command the services of the "best experts," etc, is too doubtful to constitute properly a part of an adjudication as to valuable rights of property.

The ruling that the examinations made in the Patent Office, though "*ex parte* in form," "are nevertheless," as stated in the extract above quoted, "*conducted under hot and skilled contestation in every case of importance*," is wholly an error. The only contests which can possibly take place in the Patent Office, under any Act of Congress now in force, are in interference cases, and Boyden and Westinghouse were never in interference. All other cases are *ex parte*, the proceedings therein are secret, and as to them no contest can possibly arise.

These errors, though comparatively small in themselves, lead up to two other errors, both of which are material.

By the grant of a later patent to Boyden, it is stated, in the extract above quoted,

"that the action by the Office was, in effect, a ruling that the "Boyden device *did not infringe* Westinghouse's quick-action "patent number 360,070."

And at that time—that is, at the time this Patent Office action was taken—it will be remembered, this case and this question were then pending in the Circuit Court.

And while so pending, the defendants procured, on the usual *ex parte* applications, the grant of the three several patents already recited, in which they inserted various statements, argumentative and otherwise, as to the relationship of their device to the Westinghouse Patent 360,070, and apparently for the express purpose of using such *ex parte* statements as evidence in their own behalf.

Nor can this ruling of the Court of Appeals be put aside as mere *obiter dicta*, and therefore of no binding force as an adjudicated precedent. Exactly the reverse is true. It is an adjudication as to the proper legal effect of certain evidence, which, with rare exceptions, is introduced into every patent case which is ever tried. Defendant almost invariably has a patent, good or bad as it happens, and defends under it. And this adjudication, made by a court of last resort, unless reversed or corrected, will be binding as such throughout the Fourth Circuit, and more or less controlling as an authority in the other circuits.

The question of infringement, under the law, does not belong to the Patent Office, and, until the present decision was rendered, it has never been so held.

The ruling or decision thus made, and stated with such freedom from ambiguity, coming as it does from a Court ordinarily, in Patent cases, of last resort, is *alarmingly dangerous* to the interests of inventors and patentees everywhere, and is *most dangerous* to those inventions which possess the *highest merit*. What would this Court have said, if it had been asked to decide, in the Telephone cases, that, by the grant of later patents to Dolbear, or to Drawbaugh, or to Edison, or to Gray—and granted *while suits for infringements were pending*—the Patent Office had made a ruling that the Dolbear, or the Drawbaugh, or the Edison, or the Gray telephone "*did not infringe*" the prior Bell

Patent? We mean no disrespect to the Court whose decision we are now calling in question, by saying that, as we understand the law, such a holding is simply revolutionary. If such be the law, then the use of the Patent Office for the purpose of presenting, if not for manufacturing, testimony, to prove an issue upon which the prior patentee cannot be heard upon his own behalf, hereby enjoys the highest judicial sanction which it can possibly receive outside of this Court, and in the hands of the infringer becomes an implement of easy use by which to make, in all cases, a perfect defense. All he has to do is to apply for and procure, at a cost of \$35, a later patent for some further detail of improvement, real or pretended. He can *assert*, in his application, that his "improvement" or "modification" is not an infringement, etc. As the Patent Office has no jurisdiction of the question of infringement (except, of course, in interference cases, and then only for the purposes of the grant), such assertions in a specification are generally allowed to go unchallenged, and are left for the Courts to pass on. The *claim* is usually scrutinized—nothing else is (100 U. S., 671-2). Then, no matter how limited the claim, or how trivial the invention, the later patentee, *by merely getting a patent*, obtains, under the decision now in question, an *ex parte* ruling, not merely that his device involves some patentable additions to, or modifications of, the prior patent, but that it departs so essentially from the *claims* of the prior patent that it does not embody its essential features at all—or, in other words, that it *does not infringe*. By the mere grant of a patent so procured, he would have, under Judge HUGHES' decision, a ruling by the Patent Office of *non-infringement*, which he could properly use as a defense.

Such a defense, so made, has thus been held not merely to raise a *prima facie* presumption that the later patent involves some patentable differences from the prior patent, but that its grant, though not conclusive, is *prima facie*, at least, sufficient as a defense; and this ruling has been made by a Court of last resort; and, if the error be not corrected, it will work irreparable injury, alarming both

in amount and extent, to the most meritorious inventors of our nation, or of the world.

The facts, upon which this singular decision was made, are correctly stated by Judge MORRIS in his decision, and his ruling thereon may properly be quoted here as being substantially correct in its application of the law to those facts. Judge MORRIS (66 F. R., 1006, 1007) says:

"It is further urged that in a doubtful case the scale should be turned by the fact that, subsequent to the date of the patent in suit—indeed, more than two years after the institution of this suit—Patents Nos. 481,134 and 481,135, August 16, 1892, were granted to Boyden for the mechanism now used by the defendant.

"Boyden was entitled to patents for whatever was a patentable novelty in the devices by which he was able to make his valve 22 answer for both service and quick-action work in connection with the restricted passage B, and for any other patentable novelty in the forms of his mechanism. The widely different forms in which he has illustrated his devices in the two above-mentioned patents show that—taking what Westinghouse had discovered and demonstrated to be the underlying principle of a quick-action brake—a skillful and inventive mechanic can devise many forms for applying it.

"But, in his specification of Patent No. 461,135, Boyden alleges that his device differs essentially from Westinghouse's Patent No. 360,070, and involves a new mode of operation. *The question whether it does or does not was the very question then pending in this suit*; and, so far as the Examiner passed upon it, in allowing the specification to stand, he did so upon the *ex parte* application of Boyden and unassisted by testimony as to the state of the art at the date of the Westinghouse Patent, and without testimony as to the scope of the Westinghouse quick-action invention and its great importance and merit, and, therefore, without the opportunity of judging whether or not it was a pioneer invention of a fundamental character, entitled to construction co-extensive with the invention, or was simply a patent for an improvement in a known art, to be restricted to the form of the device shown in the model and illustrations."

"The determination of that question is the starting point in the consideration of the controversy, and, in my judgment, the fact that Westinghouse was the first discoverer of the vital underlying invention should turn the scale in his favor."

Contrasting with this the ruling made by the appellate tribunal, it is respectfully, but urgently, submitted that an error, in its probable results so fraught with danger to the most meritorious

inventors known to the law, should not be allowed to pass without correction ; and this is the only Court where it can be authoritatively corrected.

Not only is it true that the Patent Office has no authority to decide, or even pass on, a question of infringement for the Courts, but it is equally true that the Patent Office is not authorized to make or create testimony for the Courts.

While the decision herein complained of does not go to the extent of holding that a Patent Office ruling is *binding* on the Courts, and, in fact, says that it is not "conclusive," it does give to such ruling an effect which, to say the least, has no foundation in law, and also is highly pernicious. In the sentence next following the clause last quoted, Judge HUGHES says of this Patent Office ruling that it "takes rank here as the testimony of experts of the highest experience, skill and knowledge in mechanics."

It would seem to be almost needless to suggest that, if a subsequent improver on a pioneer invention can, by the mere *ex parte* act of procuring a subsequent patent, especially *after being sued*, make or create "testimony" for himself—and testimony which may "take rank" in a Federal Court as that "*of experts of the highest experience, skill and knowledge in mechanics*"—then one of the great safeguards erected for the protection of patented property is entirely destroyed. *On mechanical questions the law knows no higher testimony than that which is thus defined ; and hence, when such testimony is furnished, it cannot successfully be rebutted.*

And if this be a correct statement of the law, then, in patent cases, under the issue of infringement, the Courts will have little to do (except in cases of *manifest error*) but to register and enforce the *ex parte* rulings of the Patent Office.

Miller vs. Eagle Manufacturing Co., 151 U. S., 186, stated the rule that the grant of the later patent merely raised "a *prima facie* presumption" of the existence of a "patentable difference" in the later patent (p. 208). But a "patentable difference" does not negative the charge of infringement.

In other branches of the case, this Court distinctly declined to follow and apply a ruling of the Patent Office as to the existence of patentable difference between two patents issued by the Patent Office (p. 202).

It has often been ruled that an apparatus is none the less an infringement because it embodies an improvement, and has been patented as such.

The decision of the Circuit Court of Appeals of the Fourth Circuit goes far beyond any decision of this Court in attributing weight and value to the *ex parte* rulings of the Patent Office.

The decisions heretofore made by this Court are believed to be in strict accord with the views we are seeking to present.

The question arose in *Blanchard vs. Putnam*, 8 Wall., 420. Mr. Justice CLIFFORD, in rendering the opinion of the Court (p. 426), said :

" Attempts are often made in the trial of patent cases to introduce such collateral issues on the question of infringement, but they are irregular and cannot be sanctioned, as the only proper comparison on that issue is of the defendant's machine with that of the plaintiff, as prescribed in the pleadings. What the jury have to determine is, does the machine of the defendant infringe the machine of the plaintiff; and, if it does not, then the defendant is entitled to a verdict; but, if it does infringe the plaintiff's machine, then the plaintiff is entitled to his remedy, and it is no answer to the cause of action to plead or prove that the defendant is the licensee of the owner of another patent, and that his machine is constructed in accordance with that patent.

" Controversies between litigants in court cannot be completed in that way, nor should the plaintiff be subjected to such outside issues, as he is clearly entitled to a verdict when he has proved that he is the original and first inventor of his improvement, and that the defendant has infringed his patent."

The present case comes exactly within the rule thus stated, in these essential features :

- (1) A pioneer patent to complainant.
- (2) A structure or device made by defendant.
- (3) An issue of infringement raised thereby.
- (4) A later patent under which defendant claims to be working.
- (5) A case for final disposition, not for the preliminary injunction.

Under these facts and conditions, *Blanchard vs. Putnam* says that the patent under which defendant claims to be working is not admissible in evidence *at all, under the issue of infringement.*

Later cases which *look like* modifications of this rule, relate, for the most part, if not entirely, either to some side or collateral issue, or else are exceptional in their nature.

In *Boyd vs. Tool Co.*, 158 U. S., 260, neither party was a pioneer, and both applications were pending at the same time—a very different case.

In *Parcement Co. vs. City of Elizabeth*, 4 Fish., 189, cited in *Boyd vs. Tool Co.*, the question arose *on a motion for a preliminary injunction.* In such proceedings, presumptions sometimes count as evidence, and hence a patent to defendant is worth something in support of a presumption.

But on final hearing, or what is practically the final disposition of a case, mere presumptions do not count for much. And even in *Miller vs. Eagle Co.*, it was merely referred to as a confirmatory consideration, and then only as of a *prima facie* character.

In *Woolensack vs. Reiher*, 115 U. S., 96, the effect to be given to a Patent Office decision arose under a question of reissue. More than two years had elapsed between the date of the original patent and the date of the reissue. Proofs satisfactory to the Commissioner of Patents had been submitted to the Patent Office, so as to account for the delay, and the Commissioner, being satisfied with those proofs, had granted the reissue. These facts were set up in the bill. Defendant demurred, and the Supreme Court, in sustaining the demurrer, after reciting the facts as above stated—that is, the decisions which had been made on the proofs so submitted—added the following (p. 101):

“ But this does not satisfy the law. The question as to whether the delay had been reasonable or unreasonable is for the Court to determine, upon the special circumstances brought to its attention, *and it cannot substitute the decision of the Patent Office upon that question for its own.*”

Hence it is believed that the law of *Blanchard vs. Putnam* is still the law of the land. And even if the later decisions cited *supra*

have tended to modify it, it has never been modified as applicable in a suit on a pioneer patent, and, still further, has never been so far modified that a grant of a patent beomes "testimony of high rank" as establishing non-infringement in a Federal Court, and, still more so, when the later patent is not procured until more than two years after suit is brought.

It is submitted that the effort to raise *ex parte* departmental decisions to, practically, the rank of adjudications, which are authoritative as "testimony" in Federal Courts of last resort, embodies so great and dangerous an error as to create an unusually urgent call for the intervention of this Court, by the exercise of its statutory powers of review.

And it is also submitted that the decision rendered hereon by Judge MORRIS, as quoted above, is substantially correct and should be affirmed.

**Patent Office Proceedings, in the Application for
Patent 360,070, Contain Nothing Which Require
Any Other Than a Broad and Liberal Construc-
tion of the Claims Here in Issue.**

The particular form of embodiment of the Westinghouse quick-action invention, shown and described in Patent 360,070, contains an emergency valve which is *not integral* with the main valve of the triple valve; that is to say, the two are not made of one and the same piece of metal. But Mr. Westinghouse was fully aware of, and recognized, the fact at the time, that whether the two valves were made integral or non-integral (that is, of one piece of metal, or two pieces of metal) was wholly immaterial, and he stated this fact in his specification, as originally filed. Thus, he said (Rec., p. 714):

"Further, while in the specific construction described and shown, the function of admitting air from the main pipe is performed by a valve separate from that which effects the preliminary admission of reservoir pressure to the cylinder, a modification in which the same office is performed by a valve integral with the main valve and

formed by an extension thereof, would be included in and embody the essential operative features of my invention."

This application was filed November 19th, 1886.

Under date of January 14th, 1887, the Patent Office wrote a letter, running as follows (Rec., p. 717, fol. 1172) :

" Claims 1 & 2 are anticipated by patent No. 280,285 to G. A. Boyden, June 26th, 1883 (steam & air brake attachments).

" It is desirable that a working model of the triple valve be furnished."

Claim 1, which was thus objected to, read as follows (Rec., p. 714, fol. 1166) :

" 1. In a brake mechanism the combination of a main air pipe, an auxiliary reservoir, a brake cylinder and a triple valve provided with a device for admitting air directly from the main air pipe to the brake cylinder, substantially as set forth."

This claim did not, in terms, as do the claims in suit, point out that the " device " is one for producing " quick action," nor that it is operated by the movement of a triple-valve piston.

This action of the Patent Office led to a re-examination of the claims as drawn, and it was then found that, while claim two was not open to objection, claim one was, *under the literalism of its terms*, broad enough to cover certain pre-existing *automatic-brake* mechanisms, but which, confessedly, did not *produce quick-action*. *In its literalism*, it was met by Mr. Westinghouse's own patent of 1875, No. 168,359—a patent issued ten years before quick-action was even thought of. And the Boyden Patent, which was cited, No. 280,285, was equally barren of the invention in dispute, as Mr. Boyden himself has testified in the present case (Rec., p. 497, Q. 8).

Thus, on account of a failure to distinguish, in express words, the quick-action invention from previously patented mechanisms which confessedly did *not* contain quick-action, the original first claim was erased and the present first claim was inserted. Also, disclaimer was made of the subject matter of Patent No. 280,285 (Rec., p. 717, fol. 1173 and p. 720, fol. 1177).

Thus, the technical objections to the issue of the Westinghouse Patent, as formulated in the Patent Office letter of January 14th, 1887 (Rec., p. 717, fol. 1172), were wholly obviated.

But another objection seems to have been found, which, though put in writing by the Patent Office Examiner, was made the occasion of another amendment. It appeared that the unwritten rules of Patent Office practice forbade the description, in a specification, of modifications which were not illustrated in the drawings. This rule was merely for the convenience of the Examiners in making their examinations, since they chiefly used the drawings for this purpose, and a modification, though described in the specification, was liable to be overlooked if not illustrated in the drawings. Besides, whether a proposed modification was or was not a mechanical equivalent, was a question which belonged to the Courts and not to the Patent Office. If it was an equivalent, it would come within the scope of the claim, by operation of law.

And, upon the Examiner calling attention to the rule of Patent Office practice, above referred to, the above-quoted reference to an *equal valve*, as capable of being used in lieu of a separately made valve, was erased from the Westinghouse specification.

Hogan, Rec., pp. 277-280.

Thus, three, and only three, amendments were made.

1st. A claim, which was inadvertently so phrased that by its generalism it covered or included a pre-existent *non-quick action* brake, was erased as soon as the error was discovered, and a claim which *excluded* such *non-quick-action* brake was substituted therefor.

2d. The prior patent cited by the Office (Boyden, No. 280,285 of 1883), and admitted by Boyden himself to be *non-quick-action*, was disclaimed.

3d. Under one of the technical requirements of the Patent Office, no assurance was made of *the description* of a possible modification, simply because the drawings of the patent did not contain a view or picture of such modification,—thus leaving that modification to be controlled, if at all, by the doctrine of equivalents.

The 2d in number of these three amendments is not regarded as a fact of importance, either by the Circuit Court or by the Court of

Appeals, and hence may be disregarded ; but as to the other two, the 1st and 3d, the Court of Appeals gives to them a scope and effect much beyond what we believe to be required by law, and equally beyond the strictest requirements of any equitable considerations which can be presented.

And, in their discussion of this part of the case, the Court of Appeals unhesitatingly awards to Mr. Westinghouse the highest possible rank as a pioneer inventor. Thus the Court says (Rec., p. 880, fol. 1419) :

"That this invention of Westinghouse, thus undefined, is one of the highest value to the public, and that it is a pioneer one in the art of quick-action air brakes is not denied, and is conceded. It is conspicuously one of those pioneer inventions which entitle the proprietor to a liberal protection from the Courts in construing the claim."

Continuing in the same liberal tone, the Court states clearly and forcibly certain favorable rules of construction which are to be applied in support of a pioneer invention (*Ibid*).

"If an inventor is ambiguous or obscure, or halt or limp in his language of description the Courts will help him out and so construe the claim as to give distinct identity to his device. If there be a doubt in the mind of the Court or of a jury on the issue of mechanical equivalency the Court will give and instruct the jury to give the benefit of the doubt to the pioneer inventor."

Thus far we have but little to except to. But the next sentence which, for convenience of reference, we designate as (A), and the two following paragraphs which, for like reason, we designate as (B) and (C), are, in their relationship to this case, open to comment. They run as follows (Rec., pp. 881, 882) :

(A) "But where the inventor falls so far short in his description as to claim only the result which his machine accomplishes, and omits an explicit definition of the *means* by which he does it, as in the case at bar, the courts have another duty to perform, one which they owe to the public and to the worthy fraternity of inventors, and must decline to give him general rights where he is entitled only to special rights."

(B) "The inventor in the present case seemed himself to feel that his claim was too broad in terms. In his original application for patent 360,070 his first claim was couched in this language : 'In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake-cylinder, and a triple valve provided with a device

admitting air directly from the main air pipe to the brake-cylinder.' This language covered *any device* which might accomplish the object mentioned, and he found it necessary to erase it from his specification, and to substitute claim 1 as it now stands."

(C) "In the same specification Westinghouse had also used this language: 'Further, while in the specific construction described and shown, the function of admitting air from the main pipe is performed by a valve *separate* from that which effects the preliminary admission of reservoir pressure to the cylinder, a modification in which the same office is performed by a valve *integral* with the main valve and formed by an extension thereof, would be included in and embody the essential operative features of my invention.' Here again is a claim for a function irrespectively of the mechanical means used in accomplishing it, which the inventor found it necessary to erase from his specification. In the suit at bar he virtually asks the court to restore to his claim the two erasures which he felt himself unable to sustain at the Patent Office. Our duty to the public and inventors at large forbids our doing so."

The first, (A), of these three extracts is, in substance, a repetition of the ruling previously made as to claim 2—that it is "fatally defective," etc. We have discussed this point elsewhere (*supra*, p. 10), and have there shown, as we believe, (1) that claim 2 is *not* a claim for "*only the result*," and (2) that it *does* contain a sufficiently explicit designation of "*the means*," and (3) that, under the invention question—"conceded" by the Court of Appeals to be "*one of the highest value to the public*" and "*a pioneer one in the art of quick-action brakes*"—Mr. Westinghouse is entitled not merely to the limited "*special rights*" which that Court is willing to give him, but also to those "*general rights*" which are co-extensive with his invention.

The extract (B) contains very little that requires comment. We cite it, in passing, merely to point out the fact that this ruling contains nothing which even tends to limit the construction of either claim 1 or claim 2 *in accordance with their terms, and with the award of each of the full benefit of the doctrine of mechanical equivalents*.

We come now to the extract above designated as (C), and herein our fifth assignment of error, as submitted with the petition for a writ of *certiorari*, is in point, the same reading as follows:

"FIFTH. As further matter of error herein, and as a matter irreconcilably at variance with the ruling of the Circuit Court of Appeals in the First Circuit, your petitioners further submit that manifest error was made by the said Circuit Court of Appeals for the

Fourth Circuit in holding as matter of law that *the mere erasure* from the original specification of a description of a proposed modification operates as a *disclaimer* of such modification."

It is believed that the following considerations are controlling :

1. We have already explained why this erasure was made—merely in compliance with a technical rule of the Patent Office that, not being separately illustrated in the drawings, it could not remain in the description. The *act* of erasure cannot have any efficiency, beyond the *reason which required it*. The erased matter was not alleged to be *untrue* ; hence there can be no presumption, from mere erasure, that it was otherwise than true. And if true *then*, it is true *yet*.

2. The truth of the matter so erased has never been called in question, either by any testimony introduced into this case or in any other way. And its truth being universally admitted, it logically follows that the *integral valve* is, in fact, the mechanical equivalent of the separate valve, and therefore, as such, comes within the scope of the valve.

3. Erasure and disclaimer are two different things. In no respect are they synonymous. In this case, Mr. Westinghouse, under rules of Patent Office practice, was not allowed to state a certain fact in a certain way—the truth of the fact not being questioned. The fact remained true, and Mr. Westinghouse remained at liberty to assert and maintain its truth at all other times and places. He was simply not permitted, for technical reasons, to state it *then and there*. Hence he erased it.

To convert this into a disclaimer, such as to deprive Mr. Westinghouse of any right therein, there must be on his part some further act of renunciation or disavowal, in respect of the thing referred to in the erased matter, such as would create an estoppel.

His right to the integral valve, as a mechanical equivalent of the separate valve, is a *property* right which the law gives him, and of which the law will not divest him by mere inference or implication.

4. This exact question arose recently in the Court of Appeals, First Circuit, and it was there decided by an elaborate and exhaustive opinion, that a mere erasure is *not* a disclaimer.

Reece Button-Hole M. Co. vs. Globe Co., 21 U. S. Ap., 244 :

The discussion of this particular question, in the case thus cited—too long to be here quoted in full—will be found at pages 369-373 of 21 U. S. App. Briefly, it is to the effect that the rule of *Leggett vs. Avery*, 101 U. S., 256, as to cases where broad claims are made, rejected and erased, and *narrower claims are inserted, or where positive disclaimers are made*, is that, in such cases, the limitations thus voluntarily placed on the scope of the patent by the patentee ought not to be and cannot be disregarded by the courts ; but that, while this is true, it is also true that the rule ought not to be extended to the mere erasures or alterations (1) which are made as to matters of detail, or (2) which, under Patent Office practice or usage, are required for making the specification conform to the drawing, and (3) least of all should such rule be extended and applied to what are known as "pioneer" patents—one of which the Westinghouse confessedly is. The Supreme Court, so far as our search can discover, has never as yet extended the *Leggett vs. Avery* rule to any one of the class of cases last above referred to, and two Circuit Courts of Appeals have decided that it ought not to be done—one in the *Reece* case, and the other in a case presently to be cited.

From the *Reece* case (*supra*, p. 370), we extract two short sentences which indicate the conclusion reached by that Court :

"Nevertheless, it defeats the very essence of this rule to extend it to what was inserted inadvertently, or to push the construction of what was thus inserted in one direction, when it is plain from the whole transaction that the parties inserting were looking in another."

* * * * *

"Courts ought, therefore, to be the more careful, under circumstances like those at bar, to give a patentee the benefit of all the equities which can be raised in his behalf by any reasonable implication from what appears on the face of the amendments, or from the transaction as it passes through the Patent Office."

And this limitation of the *Leggett vs. Avery* rule, as formulated in the *Reece* case, is approved, adopted and applied by the Circuit Court of Appeals in the Sixth Circuit.

McCormick Harvesting M. Co. vs. Aultman, 37 U. S. Ap., 299, 344, 345.

In this case, the subject is reconsidered as fully as it was in the *Reece* case, and in disposing of it the Court says (pp. 344, 345) :

"Whether he specifically claims in his patent the benefit of equivalents or not, the law allows them to him according to the nature of his patent. If it is a mere improvement on a successful machine, a mere tributary invention, or a device the novelty of which is confined by the past art to the particular form shown, the range of equivalents is narrowly restricted. If it is a pioneer patent with a new result, the range is very wide and is not restricted by the failure of the patentee to describe and claim combinations of equivalents. Nothing will restrict the pioneer patentee's rights in this regard save the use of language in his specification and claims which permits no other reasonable construction than one attributing to the patentee a positive intention to limit the scope of his invention in some particular to the exact form of the device which he shows, and a consequent willingness to abandon to the public any other form, should it be adopted and prove useful. Instances of such a limitation may be found in *Keystone Bridge Company vs. Phoenix Iron Company*, 95 U. S., 274, and in *S. N. Brown & Company vs. Stilwell & Bierce Manufacturing Company*, 6 U. S. App. 427; s. c., on petition for rehearing, 16 U. S. App., 234. But there is no such limitation in the patent under discussion, and the rule applies which was so fully explained in *Winans vs. Denmead*, 15 How., 330, 342, where the Court said: "Patentees sometimes add to their claims an express declaration to the effect that the claim extends to the thing patented, however its form and proportions may be varied. But this is unnecessary. The law so interprets the claim without the addition of these words." Again, in *Goodyear Dental Vulcanite Company vs. Davis*, 102 U. S., 222, 230, the Supreme Court said that a patentee was protected against equivalents whether he claims them or not. A most satisfactory discussion of this general subject may be found in the opinion of the Circuit Court of Appeals of the First Circuit, in *Reece Button Hole Machine Company vs. Globe Button Hole Machine Company*, 21 U. S. App., 244, where Judge PUTNAM, on behalf of that Court, examines the two lines of cases of which *Winans vs. Denmead* and the *Keystone Bridge Company vs. Phoenix Iron Company*, *supra*, are respective types, and reconciles them so far as they may be reconciled."

And the *Reece* ruling herein is being extensively applied in cases at circuit.

Rhodes vs. Lincoln Co., 64 F. R., 218, 220.

Campbell Printing Press Co. vs. Marden, 64 F. R., 782, 785, 786.

New Departure Bell Co. vs. Bevin Co., 64 F. R., 859, 864.

Richardson vs. Am. Pin Co., 73 F. R., 476, 478.

Bonsack Machine Co. vs. Smith, 70 F. R., 383, 396.

Westinghouse vs. Boyden Co., 66 F. R., 997, 1006.

5. The ruling herein of the Court of Appeals for the Fourth Circuit, especially as applied to pioneer inventions, is strongly in derogation of the rulings of this Court in a large class of cases, of which *Morley Machine Co. vs. Lancaster* (129 U. S., 263) is one. It would, if carried out, completely withdraw the protective influence of the doctrine of mechanical equivalents from the most useful and beneficial inventions which we have, simply on account of a mere technicality of detail, unimportant in itself, and which, so far as it concerns the defendant, is utterly devoid of equity and, as related to the patent, is directly contrary to equity.

6. The identical question here presented, under the same patent and on the same facts, was the subject of judicial inquiry in the Second Circuit nearly two years ago in *Westinghouse Air-Brake Co. vs. New York Air-Brake Co.*, 65 F. R., 99. The case was heard by Judge LACOMBE on a motion for a preliminary injunction, but every fact and argument that could be urged on final hearing was then presented. Judge LACOMBE, in overruling this defense, expressed himself with his usual clearness and cogency (65 Fed. Rep., 101):

"Defendant relies upon the rejection by the patent office of the original first claim of 360,070 and the substitution of the present first claim as an abandonment of the fundamental broad invention therein disclosed. When, however, the reference on which the patent office rejected the original first claim (Boyden's patent No. 280,285) is consulted, it is apparent that the essential change in the claim is the phrase used to differentiate 360,070, an invention to be used 'in the application of the brake,' from Boyden's invention, whose object was to provide for replenishing, 'while the brake is on,' the air reservoir or brake cylinder, when the pressure is reduced by leakage, etc. There is nothing in the file wrapper or contents to show that the patent office required or that the inventor agreed to abandon what was the great feature of his invention—the emergency valve—or to give up whatever range of equivalents his patent might, as modified, fairly cover. Both these patents 360,070 and 376,837 are broad ones, and their claims should be construed to cover the meritorious invention they disclose, unless the language of such claims precludes such a construction. The only question really open on this motion is that of infringement."

Defendants appealed. In the Circuit Court of Appeals, the action of Judge LACOMBE under Patent 360,070 was affirmed, "*Per Curiam*," which action certainly implies no serious dissatisfaction in

the Court of Appeals with the rulings of Judge LACOMBE under that patent.

7. It is submitted that the decision of Judge MORRIS on this point, as briefly expressed in this case at circuit, should be affirmed. Referring to all three of the amendments above summarized, he says (Rec., p. 851) :

"The amendments made to meet the objections of the Patent Examiner are not to be construed to disclaim the patentee's actual invention, if such construction can be avoided without doing violence to the obvious meaning of the language.

"*Lake Shore Railway Co. vs. Car Brake Co.*, 110 U. S., 229-236.

"*Reese Buttonhole Machine Co. vs. Globe Buttonhole Co.*, 61 Fed. Rep., 956."

Defendants' "Partition 9" and "Restricted Port B." "Momentary Differential Pressures."

These considerations have already been incidentally discussed ; but the importance ascribed to them by the defendants, renders a separate and further discussion not inappropriate.

After perusing the proofs in this case, there can be no reasonable doubt as to the correctness of three or four propositions.

1st. That Mr. Boyden, in getting up or designing the defendants' quick-action valve, did so with a full knowledge of the invention here in controversy. In fact, he admits as much (Rec., pp. 514-516, Q. 25).

2d. That in getting up or designing this valve, he studiously sought to embody in it the salient features of the "automatic" brake, and also to combine therewith the direct admission of train-pipe air to the brake cylinder, to effect the "quick-action" operation, when and only when unexpected emergencies in the running of the train should require it.

3d. That he sought to do this by a form or structure of apparatus which should retain every essential element of operation and of function which is to be found in the Westinghouse apparatus,

and retain it so perfectly as, in practical use, to be interchangeable with it, and to operate with it in the same train, to do the same work, in the same way, and under identically the same conditions. And it is so stated in defendants' catalogue (Rec., p. 489, last paragraph but one) :

"The actions of this valve in graduating, full service application, quick action and the release, are the same as the new Westinghouse quick-action valve, thereby producing the same results in breaking, which renders cars equipped with the two valves perfectly interchangeable—the hose couplings being the same."

4th. Also, that he sought to design a form or structure of quick-action valve which ocularly, or *to the eye*, should differ from the Westinghouse in as many of its details as possible, but *without loss of any essential function or feature of operation.*

Thus far, we think there can be no dispute. Mr. Boyden, himself, would probably admit this much, if he has not already done so.

Boyden's assumed position, as we understand it, involves two further propositions, in substance as follows :

5th. That, in making these changes, he has made a new substantive invention of his own, which in defendants' proofs is referred to as "The Partition 9" and "The Restricted Port B," and which, as alleged, produce, or result in, a novel operation, referred to as "Momentary Differential Pressures."

6th. That, in doing this, he has not used any substantial part of the Westinghouse invention.

In reply we say :

(1) A "Restricted Port," by or through which "Momentary Differential Pressures" are alleged to be secured, is found in the Westinghouse Patent 360,070. It is there found in substantially the same combination in which defendants use it, and doing the same work of regulating pressures, and doing it in the same way. Hence Boyden's pretense that this is his invention is not sustained by the facts.

A short explanation will make this clear.

In the emergency use of the brakes, air under pressure enters each brake cylinder from *two sources of supply*, the *auxiliary reser-*

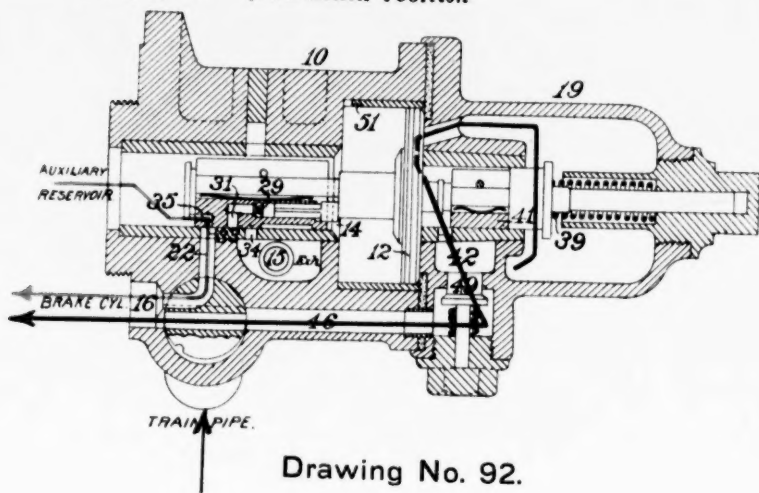
voir and the *train pipe*. Just at the instant of the shifting of the triple valve to quick-action position, the *auxiliary reservoir* pressure is the greater, since it is normal, say 70 pounds, while *train pipe* pressure has been reduced by the venting done by the engineer, who has let out 15 or 20 pounds, so bringing it down to 55 or 50 pounds. Now, it is obvious that air at 55 or 50 pounds pressure cannot be charged into the brake cylinder from the *train pipe*, to produce "quick action," if *auxiliary reservoir* pressure at 70 pounds is also admitted at the same time *with equal freedom*. Hence, in order that the *lower* air pressure from the *train pipe* may be vented into the brake cylinder of each car, so as, through a lowering of *train-pipe* pressure on that car, to hasten brake action on the *next* car, it is absolutely necessary that the admission of *auxiliary reservoir* pressure be *choked*, or held back or occur *slowly*, while, for a moment, *train-pipe* pressure flows in *freely*. In other words, in the quick-action use of the brake, some one port between *auxiliary reservoir* and brake cylinder must be smaller in cross-section than the smallest port leading direct from the *train pipe* to the brake cylinder. With the ports so proportioned, *auxiliary reservoir* pressure will be choked or admitted slowly, so that, for a short time, the *lower* pressure from the *train pipe*, entering by the larger port, will pass into the brake cylinder in advance of the *higher* pressure from the *auxiliary reservoir*. In a moment ("momentarily"), the difference ("differential") of pressures, between *train pipe* and brake cylinder, becomes equalized, the check valve closes, and the discharge of air from the *auxiliary reservoir* to the brake cylinder then continues until the maximum braking pressure is reached.

This is what we understand that defendants' experts refer to when they talk about "Momentary Differential Pressures." Possibly they invented this three-worded name, but *the thing itself*—that is, "the restricted port" and *its operation*—is found in the Westinghouse Patent, and in every Westinghouse quick-action triple valve ever made.

To make this clear, we will refer to drawing No. 92, opposite the following page, which is a reproduction of Fig. 2 of the patent in suit (360,970), but with the devices in quick-action position.

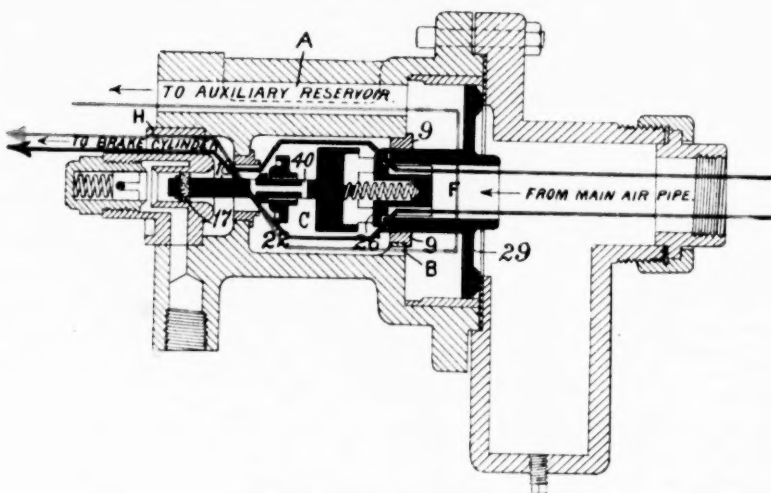


360,070: Quick Action Position



Drawing No. 92.

Defendant's Triple Valve,
Quick Action Position.



Drawing No. 95.

The blue line indicates the line of direct flow from train pipe to brake cylinder, and the port 42 and passage 46 are the passages of least capacity therein.

The red line indicates the then existing line of flow from auxiliary reservoir to brake cylinder, and the port 35 is the smallest port therein.

Inspection will show to the eye that the feeding ports 31 and 35 are much smaller than either the port 42 or the passage 46. If we measure them, taking the dimensions shown in the patent, we will find that 35 is less than one-ninth the size of either 42 or 46. In other words, port 35, which holds back *auxiliary reservoir* pressure, is less than one-ninth the size of the ports which admit *train-pipe* pressure directly to the brake cylinder.

Furthermore, the patent itself, 360,070, is careful to direct that feeding port be made, as it is made, of "comparatively small diameter." At page 4, line 57, of the patent (Rec. p. 788, top of page), it is specifically directed that—

"The feed opening for the admission of air from the auxiliary reservoir to the brake cylinder, is *purposely made of comparatively small diameter*, it having been determined by experiment that the initial application of the brakes should not be made with maximum force, and *this opening may be made of such size as to apply the brakes exactly in accord with the requirements of the most efficient work.*"

Then, as *train-pipe* pressure flows freely through ports 42 and 46, such pressure soon becomes equalized in the brake cylinder. Then the "momentary differential" condition of things ceases, the check valve 49 closes, and *auxiliary reservoir* pressure continues to flow in normally.

Defendants have not only appropriated the Westinghouse quick-action invention, as a whole, but they have also copied this specific feature of the Westinghouse quick-action valve, with no change whatever, except *in the location* of the small or restricted port. Drawing No. 95, on the opposite sheet (taken from defendant's own "illustrative cuts," No. 8, Rec., facing p. 498), shows defendant's valve. The restricted port B, in the partition 9, corresponds, in all essential respects, to the Westinghouse restricted feeding port 35. It

is, in the quick-action operation, located in the line of flow of pressure from the auxiliary reservoir to the brake cylinder, as illustrated by the red line, just as is the Westinghouse port 35. It is much smaller in size than is defendants' emergency valve port 22, just as Westinghouse port 35 is smaller than his port 42. Defendants may have a slightly greater difference in the relative sizes of the two ports, but this is only a matter of degree. The difference itself is material and substantial in both cases; it is utilized in both to do the same work, at the same times, and in the same way.

These facts, as we submit, effectually disprove Boyden's pretense that this is his invention. It is not. It is found in the patent in suit. He may have invented the particular form of partition 9, but the Court will observe that the partition 9 has no utility whatever, except as it contains the restricted port B, which simply provides for holding back auxiliary reservoir pressure, and thereby secures what Boyden calls "Momentary Differential Pressures." But the restricted port was not his invention, nor was he the first to employ "Momentary Differential Pressures," in operating quick-action brakes. Westinghouse preceded him in both.

Complainants' proofs in support of the above are full and complete.

Newbury, Rec., p. 163, fol. 247, Q. 205.

Complainants' expert, Barnes, also sums up his views in the following brief sentence (*Rec.*, p. 373):

"The restricted passage 35, of complainants' valve, and the restricted passage e, of defendants' 1889 valve, and B, of defendants' 1891 valve, are identical in purpose and function."

Mr. Barnes' reasons for so testifying are given at length at *Record*, pages 372, 373.

Also, in confirmation of the correctness of his conclusions, Mr. Barnes subjected them to actual test.

Barnes, Rec., p. 386, fol. 599 (*d*).

As to the partition 9 of defendants' valve, Mr. Newbury states accurately and fully its relationship to the other operative parts of the mechanism.

Newbury, Rec., pp. 158-160, Qs. 200-202.

Mr. Newbury's cross-examination herein is lengthy and extensive (Rec., pp. 206-235, x-Qs. 236-288).

And that "momentary differential pressures" have actually been used in the Westinghouse valve for many years, and, in fact, that they were employed in the automatic triples, see H. H. Westinghouse (Rec., p. 287, Q. 417), where, in replying to defendants' expert, Arch, he says:

"It is evident that Mr. Church's lack of practical experience has misled him to fail to observe that the principle of momentary differential pressures is not new, and that it is not embodied for the first time in defendants' structures.

"All practically operative triple valves, whether of the kind used prior to 1887 or those subsequently devised, perform their functions properly when momentary differential pressures are created by the means of restricted passages.

"The presence of restricted passages, for the purpose of creating momentary differential pressures, is required for the same purpose in the defendants' structures as in that shown in Patent 360,000, and it does not exist in any different degree in any of these structures."

We submit with the utmost confidence that these proofs fully refute Mr. Boyden's contention that he is the inventor of that which defendants contend is the distinctive feature of their valve, and also show that these features of "momentary differential pressures" required by "a restricted port B" should be credited to Westinghouse, along with the other essential features of novelty and utility which are admitted and everywhere adjudicated to be his.

And, this being so, Boyden's merits as an inventor drop out of the case. All he has done is to take the essential elements of the Westinghouse quick-action invention, embody them in somewhat different but equivalent forms and relationships, but retaining every substantial feature or element of construction, function and operation.

Removing Partition 9.

Great stress is laid by defendants on what happens, upon the removal of the partition 9. When there is no partition, there is only a *single, unobstructed and large* passage for the flow

of auxiliary reservoir air into the passageway, which *should* conduct train-pipe air to the brake cylinder, in order to cause "quick action." But, under *that* condition of things (as Westinghouse had already shown), there can be *no* "quick action," as train-pipe air cannot flow into a passageway already filled with air at a higher pressure. The two passages may, at some place, join, but must be *so far* separated that the flow of auxiliary reservoir air shall not prevent the flow of train-pipe air, when "quick action" is required. Partition 9, with its restricted port B, accomplishes this. The principal thing which happens, in removing partition 9, is that the removal of the partition necessarily involves the removal of the restricted port B. The partition 9 is of no importance in the case, nor in the device, except as it contains the restricted port B. And this restricted port, as one of the incidents of quick action, has been taken and appropriated by defendants, along with the main invention. As we have clearly shown, they were seriously in error in claiming that it belongs to them.

Boyden's 1883 Patent, No. 280,285.

As this patent figures more or less in the testimony, it should perhaps have a few words of comment.

1st. It is not pretended that it contains, either in form or in substance, the quick-action invention here in controversy. Boyden, himself, says of it (Rec., p. 497, Q. 8):

"I wish to state here that my 1883 patent was not for a 'quick-action' valve (as that term is now understood)."

Again (Rec., p. 574, x-Q. 195), he admits the following to be correct, *italics* and all.

"In the triple valve of patent 280,285, *no application whatever* of the brakes is effected by the passage of main air-pipe air to the brake cylinder, and no main air-pipe air is admitted to the brake cylinder until *after* the brakes have been applied with the maximum rapidity and force within the capacity of the device *by auxiliary reservoir air alone.*"

And again in the same answer he says :

" I did not wish to imply, nor do I now, that my 1883 patent is for a quick-action valve such as you have stated."

And the patent itself is in accord with these admissions. Thus the specification sets forth (Rec., p. 776), as the first and main object of the invention (the italics being our own) :

" *To provide for replenishing, while the brake is on, the air reservoir on each car or the brake cylinder, when the pressure therein has been lessened by leakage.*"

Judge MORRIS' decision followed the lines thus indicated, with the result of finding (Rec., p. 849), that, as between the Boyden patent of 1883 and the Westinghouse Patent No. 360,070, "*there seems to be no analogy or comparison which can be made between them.*" Hence, this Boyden Patent of 1883 was ruled out, as of no effect in the case.

No exception was taken to this ruling, and the Court of Appeals did not even refer to this patent.

Hence, we presume that it may be disregarded, except as to three facts.

FIRST: THE DISCLAIMER.

In order to draw clearly the distinction between what was old and what was new, Westinghouse was required to disclaim in his specification this Boyden 1883 device. He did so. It is then argued that this disclaimer operates as a limitation, not as to something which, being old, he *could not* claim, but as to something which, *being his*, he *has claimed*.

Non sequitur. He merely disclaimed a device or mechanism which was prior in date, but which had no substantial identity with the invention of his. He disclaimed, not a part of his invention, but *something else*. Boyden says three times, under oath, that it is *something else*. The patent itself says that it is *something else*. Judge MORRIS says, judicially, that it is *something else*. Defendants, by not excepting, practically admit that it is *something else*. Hence, in disclaiming it was a nugatory act, which did no good and no hurt.

If A and B are different things, the owner of B does not, by disclaiming A, limit at all his right to B, and to everything that appertains to B.

SECOND : THE CHECK-VALVE DEFENSE.

Mr. Boyden, when on the stand, also tried to make it appear that he was the first to put a check valve in the passageway or port leading from a train pipe to a triple-valve chamber—that is, his check valve 26; that such a check valve was contained in his patent of 1883, No. 280,285, and was transferred to defendant's present valve (Rec., p. 497, Q. 8).

The evident purpose of this was to acquire some credit to himself as an independent inventor.

We prove, in reply, that he did not invent this any more than he invented the restricted port. It is found in two U. S. Patents of 1875, and in an English Patent of 1879—long prior to Boyden's 1883 Patent.

Newbury, Rec., p. 160, Q. 203.

THIRD : ANOTHER ALLEGED BOYDEN INVENTION.

Mr. Boyden also tries, in the same connection, to get some credit out of the alleged fact that he showed in his old 1883 patent "a single valve H arranged to govern a port through which the air pressure from the main air pipe and the air pressure from the auxiliary reservoir both pass to the brake cylinder" (Rec., p. 497, Q. 8).

As we have already seen, he did this in his 1883 patent merely *to replenish loss by leakage; not to apply the brakes*. That was already done, and done just as in the old automatic brake. Through the *same passages and ports* which were used in applying the brakes, Boyden proposed to replenish loss by leakage.

As Boyden has three times admitted that this did not involve quick action, we need not discuss *that* question further. But as to the "*something else*" which he says, or at least implies, was his, we show that it, too, was older in the art than 1883. It is found in English Patent No. 3000 of 1879 (Rec., p. 163, fol. 246).

It is hence submitted :

1st. That as an inventor of any *substantive matter of invention*, whereby the Boyden valve is, *as to its essential elements*, differentiated from the Westinghouse, Mr. Boyden has no standing whatever. That feature on which he bases his chiefest claim, "the Restricted Port B" in "the Partition 9," whereby to secure "Momentarily Differential Pressures," all this was taken bodily from Westinghouse.

2d. That as regards any claim of credit to himself on account of any substantial addition made by himself to the art prior to 360,070, Mr. Boyden has just as little standing as before. Hence :

3d. That as regards defendants' present infringing valve, Boyden is not entitled to rank any higher than that of a subsequent improver, in mere details, of a pioneer invention of unimpeachable novelty and immeasurable utility.

"Substantially as Described."

In our assignments of error filed with our petition for a writ of certiorari, we submitted the following :

"FOURTH. And as matter of error and variance herein, your petitioners respectfully represent that the force and meaning of the phrase 'substantially as set forth,' as explained and applied by the said Circuit Court of Appeals for the Fourth Circuit, is directly at variance with the decisions of this Court, and is in error as matter of law."

The Court of Appeals, in the opinion rendered by Judge HUGHES, defined what is meant by "substantially as described" (Rec., p. 877, last two lines, and top of p. 878).

This Court, in *Lake Shore Co. vs. National Co.*, 110 U. S., 229, 235, defined the meaning of this and other like phrases, and the definition then given is, as we understand, generally recognized by the profession as still authoritative and binding. It runs thus—the italics being our own :

"the words 'substantially as specified' mean substantially as specified *in regard to the combination* which is the subject of the claim."

Nor was this an *obiter dictum*. The issue of infringement turned upon the meaning and force of these words.

This decision was cited in the Court of Appeals in the argument of this same issue in the case at bar. That Court disregarded the rule or definition thus cited, and held, as we understand their decision, that "substantially as described" relates not to *the combination* which is the subject of the claim, but to the *separate or individual elements* which make up the combination.

And this variance is material and important in that the decision as thus made by the Court of Appeals, as a Court of last resort, may be regarded as final and authoritative in the Circuit Court of that and possibly other Circuits.

It is believed that the error thus made should be corrected by an affirmance of the rule formulated in *Lake Shore & M. S. Co. vs. National Co.*, *supra*, or in such other manner as may seem good to the Court.

The Westinghouse Patent 217,838.

A copy of this patent will be found at record, page 759.

It is not claimed anywhere in the proofs, or elsewhere, so far as we know, that this patent contains or anticipates the invention here in suit.

Judge MORRIS says of it (Rec., p. 847):

"It is true that, in searching for some device which would give quick action, Westinghouse had, before the date of the patent in suit, conceived the idea that it might be accomplished by venting the train pipe at intervals along the train. He had tried having two or three vents at intervals in the length of the train controlled by electrical apparatus, and also had tried relief valves placed in the pipe coupling of each car which would open to the atmosphere and vent the train pipe quickly in case of accident or other sudden release of pressure in the forward part of the train. This was shown in the Westinghouse Patent No. 217,838, July 22, 1879, but neither of these attempts were successfully applied, and *they did not solve the problem of quick action.*

"*The problem was not solved; indeed, the first step in the direction of solving it does not appear to have been taken until the experiments which led to the Westinghouse patent now in suit.*"

As defendants took no exception to this ruling of Judge MORRIS, it may be inferred that they are satisfied with its correctness.

The principal effect of this Patent 217,838 is in that it tends to show that as early as 1879 Mr. Westinghouse *tried* to make a quick-action brake, but at that time he did not know how.

The result was that he made a mechanism which was inoperative and worthless for any practical use, except as it told all subsequent inventors that *that way had been tried and had failed* (Newbury, Rec. p. 189, Q. 223; Barnes, p. 405, Q. 699).

Really, this issue of inoperativeness was of doubtful relevancy, under the pleadings. As already stated, this device of patent 217,838, did not contain the invention in question, and nobody had said that it did; but as defendants' experts had tried to give it some prominence as a part of the state of the art, we considered it a sufficient reply to prove its inoperativeness.

Defendants, by special leave of Court, undertook to reproduce the apparatus of this patent, and by testing it to show that it would work. Mr. Boyden testified as to these tests, and finally, on cross-examination, he admitted that:

"The results produced by the devices of patent 217,838, *as I tried them*, are not of an efficiency that would justify me in recommending the use of the devices to railroad officials." (Rec. p. 692, X Q. 346).

In the next following answer, speaking of the same apparatus, he says that it "was not practically operative to be used in service."

And when pressed for his opinion, in the question next following, he says:

"My opinion is that the device *as I used it* would not be acceptable to railroad officials for practical use."

While it is hardly necessary to reply to such testimony as this, we proceeded, perhaps out of excess of caution, to prove, in reply, (1) that Boyden, in his efforts to make the apparatus work, had departed from the instructions of the patent; (2) that he had done this without any warrant whatever; (3) that the change or departure which he had made, destroyed the *intended* operation of the device—that is, that the apparatus as he changed it, would *not* operate in the manner described in the patent, and (4) that what

little success he did attain in making his apparatus work, was due to the *unauthorized change* which he made in its structure.

This, as well as Boyden's admissions, quoted above, amply confirm what we said at first—that it is an inoperative mechanism.

The replying testimony of Westinghouse is not lengthy, and fully sustains the four points last above stated (Rec., p. 829 *et seq.*).

Sundry Theories of Defendants' Experts.

It would unduly lengthen the present brief, were we to follow in detail *all* the erroneous or misleading distinctions which defendants' experts elaborate at greater or less length. Nor is it thought to be necessary, in view of what is believed to be the controlling character of the considerations already presented. But we may properly note them, lest it be thought that we have no reply.

1. Effort is made, through page after page, to distinguish the Boyden quick-action valve 22 from the Westinghouse quick-action valve 41, for the reason that the latter valve is a "*separate*" valve from the valve 14, which primarily governs the flow of *auxiliary reservoir* air to the brake cylinder.

This is wholly a fallacious distinction. The Boyden valve 22 is a "*separate*" valve from the Boyden stem slide valve *i, k, j*.

The feature of "*separateness*" of construction and operation, is mechanically and functionally as fully present in one as in the other.

2. It is also said that the Westinghouse quick-action valve 41 is an "*added*" valve—that is to say, that it was added to the triple mechanism of 220,556, in the making of the invention in suit.

This is at least an effort at a *misleading* distinction.

Defendants allege that their quick-action valve 22 is a modification of another old Westinghouse triple valve—that of Patent No. 141,685—a modification of the plug valve *o*. We have already, with some fullness, discussed this theory of theirs, but a word or two more may be in place.

Assuming that what they say in this respect is true—that they

did modify 141,685, and that they modified it along the lines which they now point out, *how did they do it?*

We contend that they are in error in their understanding of the modifications which they say that they made, and we have endeavored *supra* to show the facts in their true aspect. But we will now assume—but only for the sake of argument—that the Boyden valve 22 is a modification of the plug valve *o* of 141,685.

How, upon that assumption, was it modified?

It will be seen that the plug valve *o* of 141,685 is rigidly connected by an intermediate stem with the diaphragm which moves it. Boyden, in making his alleged modifications, after changing its form from a “*plug*” to a “*poppet*” valve, *detached it from its stem*, so that it was no longer rigidly connected thereto as before, but could remain in place during the “*preliminary traverse*” of the piston and stem.

This loosening of the valve from the immediate control of its stem *made another valve of it*. It acquired by such change and modification a new capacity and function. It was no longer the same valve either in structure or in operation. In both respects it was materially altered. It was a “*main*” valve *before* the change; it was a “*quick-action*” valve *after* the change.

The change being made, Boyden had next to provide a “*main valve*.” Hence, the stem hole *i, j, k* was bored and the sliding stem became the main valve.

Hence, defendants’ contention amounts simply to this:

Westinghouse had a “*main*” valve, which, algebraically, we will call *a*, and which in its perfected form (220,556) answered his purpose.

He invented and, as defendants contend, “*added*” thereto a “*quick-action*” valve, which, algebraically, we will call *x*, as it was previously unknown.

Boyden took an older form of the known “*main*” valve *a* (141,685), modified and changed it till he had put into it the essential features of novelty and utility which belonged to the new quick-action valve *x*, and then “*added*” another “*main*” valve *a* in lieu of the “*main*” valve which he lost by making the change.

Both triple valves contain $a+x$, as the final result of the working out of the equation. Hence there is no substantial difference due to the way in which either was produced.

3. The analysis of "valve functions," which is made at great length by Boyden and Church in the first part of the testimony of each, in connection with the conclusions which they seek to draw therefrom, is fallacious and misleading, and is so, chiefly because:

It is based on an error of observation and of fact in the working of valve 22. Boyden and Church both failed to note or observe the fact that valve 22 never opened in ordinary *service* use, until *after* the *air-charging* work of ordinary service was substantially completed. The facts herein (Barnes, Rec. p. 391) have already been discussed (*supra*, p. 42 *et seq.*). Hence, it will be seen that Boyden and Church fell into the error of attributing to the Boyden valve 22 a "main-valve" function which the facts clearly show that it does not possess. (Newbury, Rec. p. 168, Q. 210.)

If the Court desires to go into this matter further, the facts bearing thereon are presented in the record without undue prolixity. (Newbury, Rec. p. 176, Q. 217; Barnes, Rec. pp. 355-358, Q. 660-662.)

4. Defendants refer with much apparent emphasis, to the passage 46, which Mr. Westinghouse made in the walls of his valve case, as a port for the direct flow of air, in the quick-action operation, from the train pipe to the brake cylinder. In the Boyden device, this line of flow is through an enlarged port or passageway F, made for the purpose, in the triple-valve piston 29. Effort is made to find herein a material difference.

We have already discussed this question at probably sufficient length, when considering the issue of infringement. We refer to it again only to say that an air port through the centre of the triple-valve piston, is found in the Westinghouse triple-valve patent, No. 172,064, where it is designated by the letter *s* (Rec., p. 757).

Hence in changing the direct passage way in question from the walls of the casing to the centre of the piston, defendants have not merely taken an *old and well-known substitute*, but they have taken

substitute which *Westinghouse* invented. And then, they pretend that it is theirs, and not his.

5. Because *emergencies* always existed in the running of railway trains, and because the application of brakes, in *emergencies*, has long been well-known, therefore, defendants argue that an *emergency brake* was not a new thing in the art, at the date of the invention here in question.

This involves merely an effort, by applying an *old* name to a *new* thing, to suggest that the *new* thing is *not* new.

Old brakes were applied in emergencies, but there was no brake known in the art as an *emergency brake*, until the introduction of the Westinghouse Quick Action or Emergency Brake. Emergencies in the running of trains were known; emergency applications of old brakes were also known; but an *emergency brake* was *not* known. *That thing* was first invented and patented by Mr. Westinghouse, in and by the letters patent here in suit.

It is submitted that the case should be remanded, with directions that a decree be entered for complainants.

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For Westinghouse.

GEORGE H. CHRISTY,

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Of Counsel.



203 & 206

to Chief of Christy, Denny & Bell

United States Circuit Court:

Westinghouse &
SOUTHERN DISTRICT OF NEW YORK

Filed Oct. 22, 1896.

THE WESTINGHOUSE AIR BRAKE
COMPANY,

Complainant,

215.

THE NEW YORK AIR BRAKE COMPANY,
ISAAC B. NEWCOMBE, ROYAL C. VILAS,
CHARLES A. STARBUCK and JOHN C.
THOMPSON, Directors,

Defendants.

99
IN EQUITY.

No. 5969.

116

Decision of Judge Lacombe, Sustaining the Westing-
house Quick-Action Patent No. 360,070, and
Granting Injunctions under It and under
Patent No. 376,837.

KERR & CURTIS,

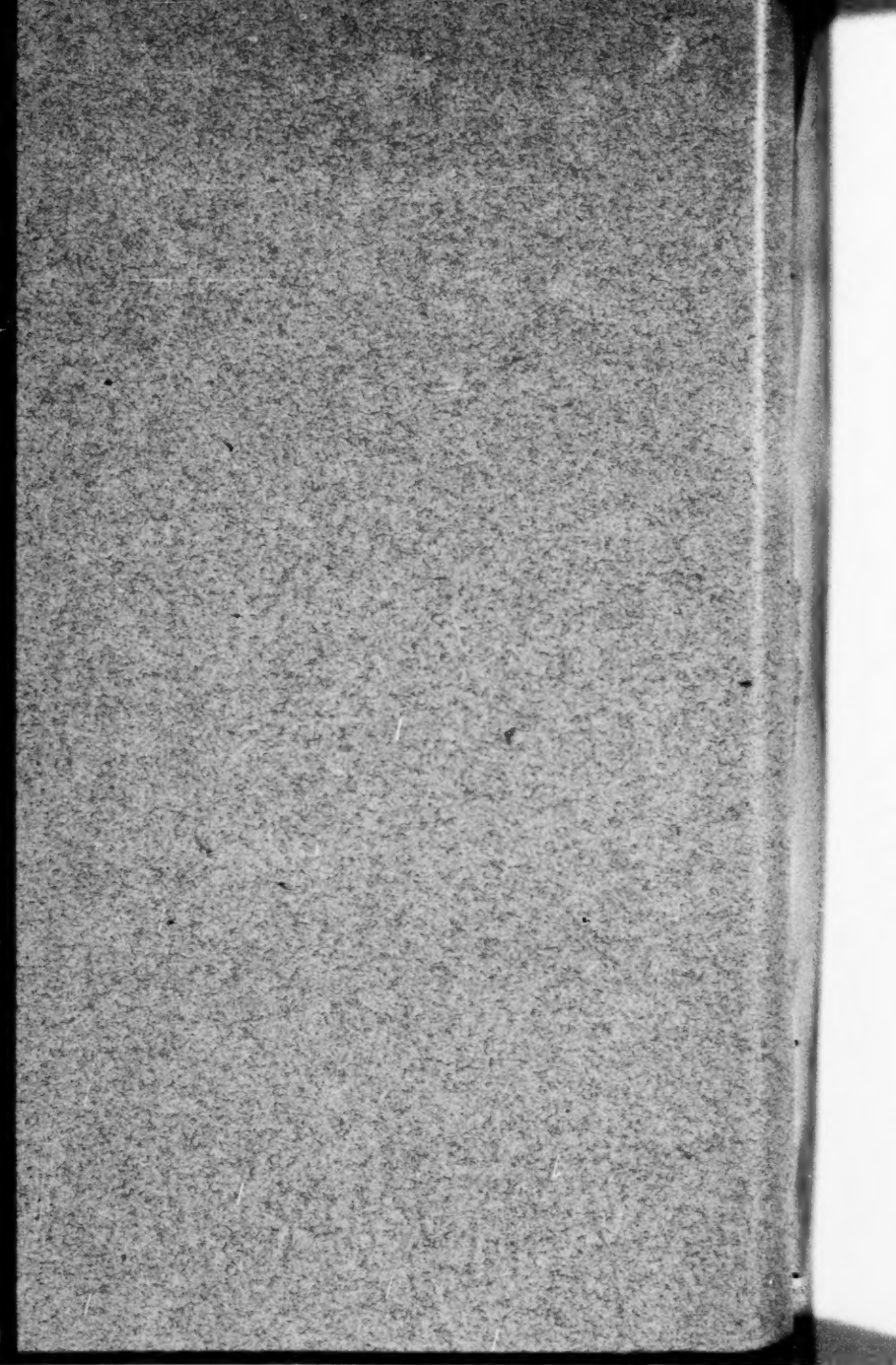
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United States Circuit Court.

SOUTHERN DISTRICT OF NEW YORK.

THE WESTINGHOUSE AIR-BRAKE
COMPANY,

vs.

In Equity,
No. 5969.

THE NEW YORK AIR-BRAKE COM-
PANY, ET AL.

This case, which comes up for hearing upon pleadings and proofs, is a suit in equity to enjoin infringement of certain Letters Patent of the United States. These patents are three in number, viz.: No. 360,070, to George Westinghouse, Jr., March 29, 1887, for "Fluid-Pressure Automatic-Brake Mechanism," complainant alleging infringement of claims 1 to 5 inclusive; No. 376,837, to George Westinghouse, Jr., January 24, 1888, for "Fluid-Pressure Automatic-Brake Mechanism," complainant alleging infringement of claims 1, 3 and 4, and No. 393,784, to Harvey S. Park, December 4, 1888, complainant alleging infringement of claims 1, 3, 4, 5, 7, 8, 9, 10, 12, 13, 14, 15 and 16.

LACOMBE, Circuit Judge :

Judicial opinion, as to the validity and construction of these three patents, has been so fully expressed in the various decisions already rendered, and which are referred to below, that no extended disquisition is either necessary or proper in this Court. Reference may be had to the opinions cited, for a statement of the reasons

which have induced the conclusions hereinafter briefly indicated.

Suit was brought in this Court upon 376,837 and the Park Patent, and came on for hearing before Judge TOWNSEND, who sustained the validity of both patents, found infringement of 376,837, and non-infringement of the Park Patent (*Westinghouse vs. New York Air-Brake Co.*, 59 Fed. Rep., 581, Nov. 20, 1893). This suit was appealed to the Circuit Court of Appeals in the Second Circuit, and Judge TOWNSEND's decision as to these two patents was affirmed (*Westinghouse vs. New York Air-Brake Co.*, 63 Fed. Rep., 962, Oct. 15, 1894). Defendants modified their device, and the suit at bar was brought to enjoin the sale or use of their new "Quick-Action Triple Valve B." Application was made, upon elaborate affidavits, for a preliminary injunction, the motion was argued at great length, was duly considered by this Court, and an opinion filed December 24, 1894, sustaining the validity of No. 360,070 (which has not been in issue in the earlier suit), and finding infringement of claims 1, 2 and 4 of that patent, and also of claim 1, of 376,837 (*Westinghouse vs. New York Air-Brake Co.*, 65 Fed. Rep., 99). Suit was also brought in the Circuit Court for the District of Maryland, on No. 360,070, to enjoin still a different form of mechanism, and the cause coming on before Judge MORRIS, March 11, 1895, he held claims 1, 2 and 4 to be valid, and found infringement of claim 2, but not of claims 1 or 4 (*Westinghouse vs. Boyden Power-Brake Co.*, 66 Fed. Rep., 997). An appeal from the preliminary injunction, issued in the suit at bar, came up for hearing before the Circuit Court of Appeals in the Second Circuit, and was decided May 28, 1895. The decision sustained the Circuit Court, as to Patent 360,070, but reversed as to 376,837, on the sole ground that the question was "too doubtful to be resolved in favor of the complainant upon a motion for a preliminary injunction, and should be reserved for disposition upon the final hearing of the cause" (*Westinghouse vs. New York Air Brake Co.*, 69 Fed. Rep., 715). An appeal

from Judge MORRIS' decision was subsequently decided by the Circuit Court of Appeals, Fourth Circuit, November 11, 1895. That Court sustained him as to claims 1 and 4 of 360,070, but reversed as to claim 2, holding that it is fatally defective in claiming only a result, and not identifying the specific means by which that result is achieved (*Westinghouse vs. Boyden Power-Brake Co.*, 70 Fed. Rep., 816).

In the light of these decisions, the questions now presented are to be disposed of.

PATENT No. 360,070.

Claims 1, 2 and 4 were sustained by this Court, on motion for preliminary injunction, and infringement found. The Court of Appeals in this Circuit has sustained that decision, in these words: "We agree with the Court below that the defendants' apparatus is an infringement of the first, second and fourth claims of Patent No. 360,070, and deem it unnecessary to add anything to the opinion." In the record now presented at final hearing, there is nothing which calls for any modification of the opinion already expressed. To enter into any extended discussion of the case, as to this patent, would be a work of supererogation, inasmuch as the case in the Fourth Circuit, above cited, has been taken by *certiorari* to the Supreme Court, and, because of the existing difference of opinion between the Courts of Appeal in the two Circuits, has been advanced on the calendar so that it will be submitted to that tribunal, for final disposition, within the current month. The fifth claim of this patent was not passed upon, on the motion. It differs from the fourth, only in adding a check valve to the combination of that claim; it is not disputed that defendants' device contains a check valve, and, if it be held to infringe the fourth claim, it infringes the fifth as well. The third claim contains, as an element, "a second admission of air from the auxiliary reservoir to the brake cylinder." Manifestly, this is a narrower claim than those discussed when the case was here before, and, since the patentee has chosen to make a

"second admission of air" material, infringement is not found in a device which substitutes a "single admission of air," although such *single* admission be continuous.

PATENT No. 376,837.

In reversing the former finding of this Court, as to the first claim of this patent, the Court of Appeals did not pass upon the merits. It held only that the question was too doubtful to be resolved, upon motion for a preliminary injunction, but should be reserved for final hearing, upon a complete record, where abundant opportunity has been given to reply to testimony, expert or other, and to cross-examine all witnesses. An examination of the record, as it now stands, has not changed the conclusions of this Court, as heretofore expressed, and it is therefore unnecessary to do more than refer to the former opinion, as stating the reasons for holding the first claim to be infringed.

The third and fourth claims have not been passed upon by this Court, and were not presented to the Court of Appeals. Both of them contain, as an element of the combination, "a passage establishing communication between said supplemental piston and an auxiliary reservoir." The complainants contend that this passage is to be found in defendants' port "*p*." Inasmuch as this Court finds "an auxiliary reservoir" in the space which is contained in the chamber *P* above the piston, and in the port or passage *p*, below the cut-off 14 in the sliding valve, it is manifest that there is no "passage establishing communication" between the supplemental piston and such "reservoir." If this Court is right in holding that the space referred to is "an auxiliary reservoir," then it abuts directly on the supplemental piston, and any "passage" between the two is dispensed with. For this reason it is thought that the third and fourth claims of No. 376,837 are not infringed.

PARK PATENT No. 393,784.

The Court of Appeals in this Circuit has held that this is a subordinate patent, and must receive a narrow construction. The feature which Park introduced into the quick-action operation, was the working of the emergency valve piston by *train-pipe pressure*. This specification states that the object of the invention is "to enable a better, quicker and more certain action to be had of pneumatic controlling devices for air brakes, * * * and, *at the same time*, have the valve, controlling the direct passage of the pressure from the train-pipe to the brake-cylinder, *under the direct action of the train pipe pressure*." In describing the operation of his device, the patentee says: "the train-pipe pressure through the pipe Z will act on the under side of the valve S, opening the valve: &c."; and, also, "It will be thus seen that the valve S is controlled on both opening and closing by the train-pipe pressure, * * * and, with this construction, the train-pipe pressure performs the office of both opening and closing the valve." Many of the claims contain words describing the valve, or the valve and passages, as "actuated by train-pipe pressure," or "controlling the pressure to the brake cylinder direct by train-pipe pressure," or some equivalent phrase. Other claims there are, which contain no such phrase; but, since Park's invention was a device for working the emergency valve piston by train-pipe pressure, the complainant's expert is entirely correct in the statement, that "all (the claims) refer to combinations of parts, which relate to the various structural features of a triple valve, in which the extra traverse of the pistons so adjusts the parts, that the valve between the train pipe and the brake-cylinder can be *opened by the compressed air in the said train pipe*. * * * The improvement that Park introduced in the art, and has described in his patent, only threw upon the main piston the extra labor of compressing the spring H; the valve S, being a poppet valve, did not have to be slidden over its seat, while under pressure, by the movement of the

piston, but *was raised by the air pressure in the train pipe*. This is thought to be an improvement * * * minor improvement of the Westinghouse Patent. * * * Thus, it will be seen that all the claims of the Park Patent relate to that improvement."

The conclusions expressed in the former opinion of this Court, when granting the preliminary injunction, and which are still adhered to, as to the relations between the defendants' valve and the first claim of Patent 376,837, dispose of the contention that such valve infringes the Park Patent. All compressed air, in any part of the entire brake system behind the engine, is, or has been, train-pipe air. It is compressed in the main reservoir on the locomotive and, thence, passes into the train pipe proper, and from that train pipe into its several branches and such chambers, connected therewith, as may admit of its entry. All agree that, while it is still in the train pipe, the force it exerts is "train-pipe pressure." All agree that when train-pipe air has passed through the charging port into the auxiliary reservoir of the original triple-valve device, or its subsequent modifications, the force it exerts is "auxiliary reservoir pressure." This Court has found, further, on complainant's contention, and against defendants' opposition, that, when train-pipe air has passed through some other port or passage into another chamber, and has been confined therein, and cut off from further connection with the source of supply, the force which it exerts is "pressure from an auxiliary reservoir," and, because of such finding, has held defendants' valve to be an infringement of Patent 376,837. If this finding be correct, defendants' valve does not infringe the Park Patent, because, in that patent, the compressed air, whose expansive force lifts the piston, is within a chamber in free communication with the train pipe; it has not yet passed beyond any barrier which segregates it from the whole body of train-pipe air, and its force may fairly be called train-pipe pressure; while, in the defendants' valve, the compressed air, by the dissipation of whose expansive force the piston is induced to move, is within a cham-

ber which has been absolutely cut off (by the slide 14) from the train pipe; it has been segregated from the general body of train-pipe air, into an independent reservoir, and its force may fairly be called "pressure from an auxiliary reservoir." For these reasons, it is thought that defendants' "Quick-Action Triple Valve B," the device complained of, does not infringe the Park Patent.

A decree will be entered, in accordance with the views above expressed.

October 13, 1896.

E. H. L.

A Copy.

JOHN A. SHIELDS,

(SEAL.)

Clerk.

Supreme Court of the United States.

OCTOBER TERM, 1896.

No. 403.

BOYDEN POWER BRAKE COMPANY, ET AL.,
APPELLANTS,
VS.

GEORGE WESTINGHOUSE, JR., and THE WESTING-
HOUSE AIR-BRAKE COMPANY.

No. 426.

GEORGE WESTINGHOUSE, JR., and THE WESTING-
HOUSE AIR-BRAKE COMPANY,
APPELLANTS,
VS.

BOYDEN POWER BRAKE COMPANY, ET AL.

SUPPLEMENTAL BRIEF FOR WESTING- HOUSE AND WESTINGHOUSE COM- PANY.

A re-argument of the above appeals having been ordered by this Court, it seems proper that a few supplemental suggestions should be adverted to, which were called to our attention by the former argument.

These will be briefly dealt with, under separate headings.

I.

Importance of the invention before the Court.

Whatever may be asserted (erroneously as we hope to show), as to the defectiveness *in form* of any claim in the patent in suit, it is impossible to deny the commanding importance of the invention which underlies the patent, and which it purports to describe and claim.

The briefs and arguments of the Boyden counsel emphasize this fact.

Less than ten years ago, air or power brakes could not be utilized for the quick stoppage of long freight trains, and, as freight trains were almost invariably long, such brakes could not be so used on freight trains at all.

The highest type of power brake which existed prior to 1886 was radically defective.

Mr. Hill states this, and the reason for it, with great clearness and precision, in his brief (p. 12) :

“ TRIPLE VALVE DEFECTIVE ON LONG TRAINS.”

“ The triple valve, thus slowly evolved from the original form of Patent No. 141,685, August 12, 1873, to the highly improved form of Patent No. 220,556, October 14, 1879, and in the latter form used by the complainants without further material improvement till the year 1888, was satisfactory for short trains consisting of eight or ten cars or less, but on long trains consisting of forty or fifty cars or more, it was not only unsatisfactory, but absolutely impracticable ; and its *impracticability resulted from the very fact that the piston had the two traverses* referred to by Mr. H. H. Westinghouse at the bottom of p. 123, namely, a partial traverse for graduating purposes, and a full traverse for emergency stops”. (Italics are Mr. Hill's.)

Mr. Westinghouse, by the remarkable invention in suit, converted the very cause of difficulty into an element of success.

While a triple valve, with a piston having the capacity for “ two traverses,” was, *by reason of that very fact*, incapable of use

in emergencies on long trains, *because*, having a piston with a double traverse, it admitted air only from an auxiliary reservoir, Mr. Westinghouse, by using the second or "further traverse" to admit "*train-pipe*" air, caused the very defect of the prior structure to be a means of reaching the *new result*.

Such triumphs in mechanics are only achieved by those whose genius is of that supreme quality which enables a commander to snatch victory from defeat.

Speaking of the *second* claim,* Judge MORRIS said (R., p. 848):

"The *gist* of that invention is the use of the further traverse of the triple-valve piston to open a *valve which admits air directly from the train pipe to the brake cylinder, with the result that the train pipe is vented, and the train-pipe air utilized.*"

It is a conceded fact that no prior mechanism comprised these features, or ever accomplished this result, *in any way whatsoever*.

By the invention in suit, air brakes on freight trains first became a possibility, and have now become a necessity of national importance.

Three times, since the announcement of Mr. Westinghouse's achievement, the President of the United States, in his annual message to Congress, has called for the enactment of laws requiring railroads engaged in interstate commerce to equip themselves with such brakes (and with automatic couplers), "in order to greatly reduce the present fearful death rate among railroad employees" (President's Message of 1890).

Prior to Mr. Westinghouse's invention, it is conceded that no device existed which could have been made the basis of such legislation.

*As shown in our prior brief (pp. 29, 30), the first and fourth claims are shown to not require a double traverse of a *single* piston, but to be based upon another feature, viz., that there shall be *two valves*, one ("the main valve") to admit air from the reservoir for service work, and the other, an "auxiliary" valve, to admit train-pipe air for emergency work.

Congress has now made the use of such brakes, on Interstate roads, imperative (Act of 1893, Ch. 196), and many of the States have legislated to the same effect, as to railroads within their limits (Rec., p. 135, see p. 202). Mr. Westinghouse, speaking in 1891, said (Rec., p. 132) :

" Previous to the Burlington Trials, the subject of legislation having in view the compulsory use of power brakes upon freight trains, on account of humanitarian considerations, was seriously considered, *but the absence of practical devices rendered legislation on this subject impossible.*

" Since the introduction of the *quick-action brake*, several of the State legislatures have enacted laws making the use of power brakes on freight trains compulsory ; and the National Legislature has had the subject before them for consideration." (Italics ours.)

The "Quick Action" brake has also demonstrated its greater efficiency, even on passenger trains, and is rapidly superseding older forms. Passenger trains, by its aid, can be stopped " in a distance from 25 % to 40 % less with the quick " action brakes than when the prior automatic system was " used " (Rec., p. 132-3).

Rarely has an invention, which complies so completely with the reason and policy of the Patent Laws, been before a Court asking for protection ; and never, we think, has an invention been more conspicuously deserving of every permissible construction to give it such a liberal scope as will " prevent the " real substance of the invention from being bodily appropriated by an infringer " (110 U. S., 229).

See principal brief, p. 31.

II.

The experiments with air-brake apparatus in the presence of the Court.

At the last hearing, the Boyden Company exhibited and operated some air-brake apparatus in Court, from which they urged that certain conclusions were to be drawn.

FIRST. That the Boyden structure could be operated when the ring or partition 9 was removed, so as to admit auxiliary-reservoir air to the brake cylinder, both intermittently (which they called "graduating"), and rapidly, for a fuller application; and that in both of these methods of operating the valve—intermittently and rapidly—nothing but auxiliary-reservoir air would enter the brake cylinder; and that then, by merely inserting the ring or partition 9, the structure was changed to a "quick-action" apparatus, which, when operated intermittently or slowly, would admit auxiliary-reservoir air only, for graduating and service work; but which, if operated suddenly, would admit train-pipe air to the brake cylinder for emergency use.

From this exhibition it was argued that the Boyden "quick-action" structure must be essentially different from the Westinghouse structure, and its operation due to substantially different causes.

Tersely put (see Mr. Hill's brief, pp. 40, 41), the Boyden valve was alleged to be *nothing* but an "old-fashioned triple valve," which became a "quick-action" valve, not by any structural change, but because it then operated "simply by *differential pressures*."

This conclusion was claimed to be deduced from the fact that the mere insertion into the structure of the ring, or partition 9, with its restricted aperture B (a part which does not move) changed it from one type of valve—the "old-fashioned triple," admitting only reservoir air—into another type of valve—the "quick-action" triple, admitting train-pipe air.

No such conclusions can be drawn from the experiment.

(a) No such a structure as a Boyden valve *without its partition* has ever been used *in practice*, for any purpose. Experiments in court, with a structure which no one uses or wants to use, are of little value or relevance.

(b) The structure exhibited in court as a Boyden structure, and without the partition 9, was *not simply* an "old-fashioned triple," but was a triple valve having *two valves*, one capable of *being opened independently* of the other. These valves are the stem valve (*i, j, k*) and the surrounding poppet or plug valve (22). Each is capable of *independent movement* to open its own port, one by the "preliminary" and the other by the "further" traverse of a triple-valve piston.

No such double-valved form of triple was known in the prior art.

The structure of Westinghouse Patent No. 141,685 (p. 736), has only a *single main valve*.

So has that of Jones' Patent No. 166,386 (p. 745).

So also with Perine Patent No. 166,405 (p. 749).

So also with Westinghouse Patent No. 168,359 (p. 752).

So also with Westinghouse Patent No. 172,064 (p. 757).

So also with Boyden Patent No. 280,285 (p. 776).

The structure of Patent No. 220,556 is alone relied upon by the defendants as exhibiting a structure having two valves. But it is *not really* a structure of the same kind as Boyden's, as is fully shown in our principal brief (pp. 72-79).

The two valves shown in Patent No. 220,556 cannot initially be made to *open independently of each other*. The main slide valve H (to which the defendants now erroneously say their valve 22 is equivalent) *always* opens, and on the *first* traverse of the piston. The interior poppet valve moves *with* it, and opens its port only to connect with one *necessarily opened by the* "main valve H." After once opening *both* valves, the sensitive poppet valve may then be *retracted* and made to *close* its port, and, incidentally, the port uncovered by the main

Diagram 1. Showing Main Valve in the
"Closed" Position. Exhaust not Applied.

FIG. 1. Patent No. 1,000,000.



FIG. 1. Patent No. 1,000,000.

FIG. 2. Patent No. 1,000,000.



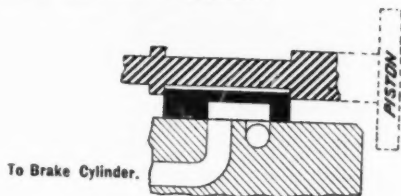
FIG. 2. Patent No. 1,000,000.

FIG. 3. Patent No. 1,000,000.

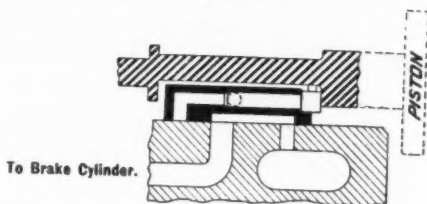


**Diagram I.—Showing Main Valve in the
“Release” Position (Brakes not Applied).**

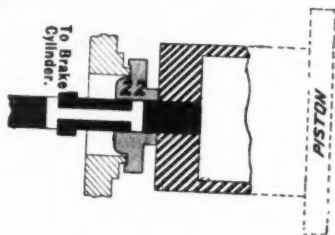
Valve of Patent 168,359.



Valve of Patent 220,556.



Valve of Boyden Structure.



valve, without retracting the main valve. No such action, *nor anything really resembling it*, is found in defendants' structure.

Boyden's valve, *i, j, k*, opens on the *preliminary* stroke of the piston, *without moving valve 22*; and when valve 22 is opened by a "further" traverse of the piston (which is the only way of opening it), *its* port cannot be closed by merely closing the port of valve *i, j, k*.

The two valves of defendants' structure are *both* capable of admitting *auxiliary reservoir air only*, to the brake cylinder, when the partition 9 is absent, because, in the structure as thus organized, there are no such air passages as to make it possible for *any* movement of the triple-valve piston to result in the opening of any port by which *train-pipe* air could be admitted to the brake cylinder.

The structure of Boyden exhibited in court (when unprovided with the partition 9) is, it is true, made to *look* like one form of the "old-fashioned triple" (Patent 141,685); but it differs from it, *and from every other such triple valve*, in this substantial respect, that it contains two *separately opening* valves; one (*i, j, k*) opening, *without moving the other*, only by a "preliminary" stroke of the triple-valve piston, and the other (valve 22) opening, *independently* of the first, *only* by the *extreme* or "further" stroke of the triple-valve piston. The latter valve (*viz.*, valve 22) is so located and arranged, with reference to the rest of the structure, that, *by partitioning the air passages* (by inserting the partition 9), it is brought into such relation with those passages that, by the "further" movement of the triple-valve piston, it will admit *train-pipe* air directly to the brake cylinder.

The accompanying diagrams show clearly how *unlike* to an "old-fashioned triple", such as that of Patent No. 168,359 (which is typical of the prior art) or of Patent No. 220,556, is the Boyden *two-valve* structure.

Diagram I. shows the "release" position of all three valves. Brakes are "off."

Diagram II. contrasts the effect of a "preliminary" traverse of the piston for a graduated application, in all three cases.

In Patent 168,359, there is only one main valve, and it has opened its port to the brake cylinder, *partially*.

In 220,556, *both* valves have moved and the ports through *both* of them are opened; but *partially* only, as regards the slide-valve port.

In Boyden's, *only* the sliding-stem valve *i, j, k* has opened.

It has opened *partially*, and its action is precisely like that of the *single* valve in No. 168,359, and that of the *main slide valve* of No. 220,556.

The characteristic function of the main valve, by which, entirely regardless of the form or shape of the valve, it has always been distinguished in the art, is to open, partially or fully, and to again close the port controlling the flow of air from the auxiliary reservoir to the brake cylinder. It will be observed, in Diagram II., that the main slide valve of each patent, 168,359 and 220,556, has been moved for this purpose, and that the corresponding valve in the Boyden structure is the stem valve (*i, j, k*).*

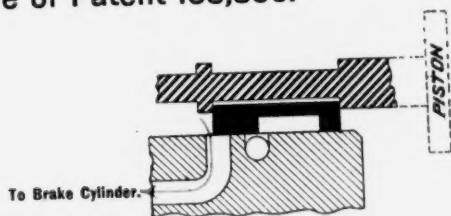
There is nothing, in this operation of Boyden's valve, corresponding to the movement of the two valves of No. 220,556, for in No. 220,556 it is a necessity that *both* valves shall move (upon either "preliminary" or full traverse of the piston) to effect *any* opening of the "main-valve" port.

* The valve that performs the functions which distinguish it in the art as the *main* valve, is, in each structure (as in our former brief), colored *black*; and the supplementary valve, which performs the *port-closing* function of the main valve of Patent 220,556, is colored *yellow*.

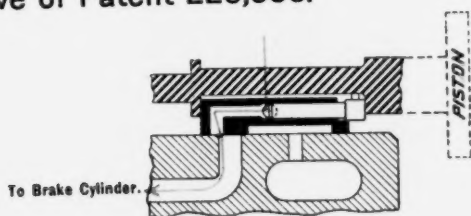
In these diagrams, only the valves and their ports are shown, the other portions of the structures having been, for greater clearness, cut away and omitted.

Diagram II.—Showing Main Valve in a Position for making a “Graduated” Application of the Brakes.

Valve of Patent 168,359.



Valve of Patent 220,556.



Valve of Boyden Structure.

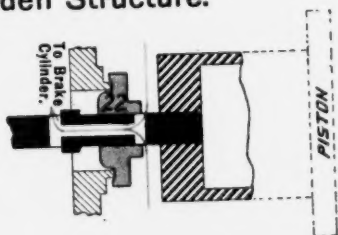
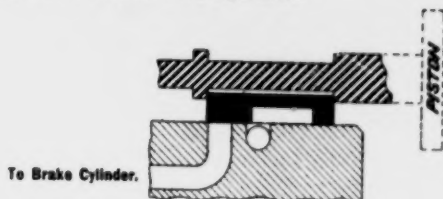
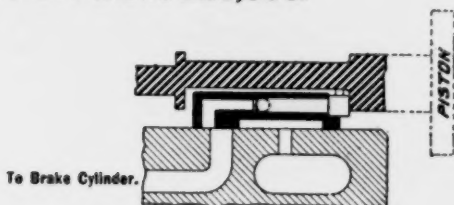


Diagram III.—Showing Main Valve in the Position for Stopping the Flow of Air to the Brake Cylinder, after making a Graduated Application of the Brakes.

Valve of Patent 168,359.



Valve of Patent 220,556.



Valve of Boyden Structure.

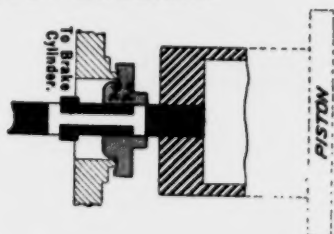


Diagram III. illustrates the function of the poppet valve of 220,556; viz., it can be made to *close* and shut off the flow of auxiliary-reservoir air without shifting the main slide valve. It can, therefore, shut off the flow of air, *even* though the slide valve may *stick* and *remain open*.

Nothing corresponding to this auxiliary method of closing the main-valve port in Patent 220,556 can be found in the Boyden structure.

The stem valve (*i, j, k*) of the Boyden structure, which *alone* [moved to open the port to the brake cylinder, has, in Diagram III., *alone* performed the main-valve function of closing the port, by moving back again from its position in Diagram II., just as the slide valve of Patent 168,359 has done, and just as does the main valve of every other form of triple valve, except one having the supplemented form of main valve shown in Patent 220,556, the main slide-valve part of which, having once been moved to open the port (as in Diagram II.), is not required to move back again to close it.

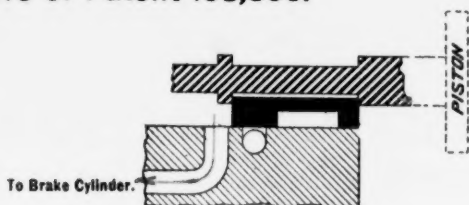
Diagram IV. illustrates the position of each valve for a full application. All three main valves—the slide valves of Patents 168,359 and 220,556,* and the stem slide valve (*i, j, k*) of the Boyden structure—have been moved far enough to *fully* uncover the port to the brake cylinder, and to thus permit the auxiliary-reservoir air to flow into the brake cylinder somewhat more rapidly than in graduated applications.

Diagrams I., II., III. and IV., collectively, illustrate *all* of the various functions of the main valve of the "old-fashioned" triple valve; viz., those of opening, partially or fully, and of closing that port which conducts the air from the auxiliary reservoir to the brake cylinder, both in graduated and in full applications of the brakes.

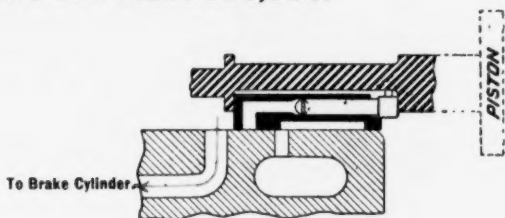
* It is to be understood, of course, that a full application of the brakes may also be obtained by causing the port *through* the slide-valve of Patent 220,556 to register *fully* with the port below it, instead of moving the slide-valve entirely off the port, as shown in the second figure of Diagram IV. But this mode of obtaining a full application does not differ from that illustrated, except that the latter affords a slightly greater access for the same air, through a longer movement of the *same* valve.

Diagram IV.—Showing Main Valve in the Position for a “Full” Application of the Brakes.

Valve of Patent 168,359.



Valve of Patent 220,556.



Valve of Boyden Structure.

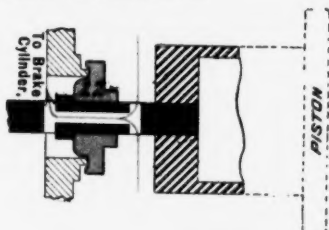


Diagram V.—Showing a New Operation of the Boyden Structure, Unknown in the Old Art, by which an Added and Independent Valve (22) Opens an Added and Independent Port to the Brake Cylinder.

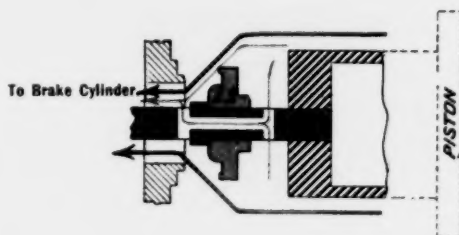


Diagram V. shows an additional operation of the Boyden structure, which has no counterpart, nor anything resembling it, in *any* form of the "old-fashioned" triple valve.

The stem valve (*i, j, k*) has here fully opened its port to the brake cylinder, in precisely the same way that it always does for a full application; *but, in addition thereto*, ANOTHER valve (valve 22), *not anywhere found in the "old-fashioned" art*, and which has been idle and inert in each of the previously described customary operations of the main valve, has *here* been moved, by the extreme, or "further," traverse of the piston, and, when so moved, has opened an *additional and independent port* (also *new* to the art) leading to the brake cylinder.

If this structure be used without any partition 9 and restricted aperture therein (as *experimented with in Court*), the opening of this *additional valve 22* will *then* (as presently to be shown) be useless and even injurious (by intensifying shocks—See p. 16 *infra*).

But if the structure be used *with* the partition 9 and its restricted aperture (as is *always* done in practice), *then*, when the *additional valve 22* is thus opened, such a *difference of pressure* ("differential pressures") is thereby produced on opposite sides of the check valve (which controls the admission of train-pipe air) that the check valve instantly opens, and *train-pipe* air pours directly under the check valve and under valve 22 into the brake cylinder, thereby producing both a "quick application" of the brakes on each individual car and a venting of the train pipe at each car, so as to produce quick serial application of the brakes from car to car.

Hence, the Boyden valve exhibited in Court was *not merely* an "old-fashioned triple" valve. On the contrary, it was an old form of triple valve *supplemented* by being provided with a *new valve*, which is opened *only* by the *extreme* traverse of the triple-valve piston, and which is *thus adapted*, upon the

insertion of the partition with its restricted port, to admit *train-pipe* air direct to the brake cylinder.

(c) The fact that the operation of the Boyden valve structure, exhibited in Court, can be changed, by the insertion of the non-moving ring or partition, from that of a valve admitting only auxiliary-reservoir air to that of a "quick-action" triple valve, which admits train-pipe air because of the production of differential pressures on opposite sides of the check valve, does not indicate that Boyden's structure differs substantially from that of Westinghouse. That suggestion is fully met by the fact, pointed out at the last argument and illustrated by a model, that the Westinghouse "quick-action" valve also operates as a "quick-action" valve *exclusively* by the production of differential pressures on opposite sides of the check valve (49), caused by the opening of the emergency valve (41); and that the whole character of the Westinghouse valve can also be changed from a "quick-action" valve to a valve which is substantially only an "old-fashioned triple" (because it admits only auxiliary-reservoir air) simply by the removal of a portion of the *partition* X, and thus enlarging, or doing away with, the *restricted* port, which, when present, holds back or chokes the flow of auxiliary-reservoir air, and causes a lower pressure to exist on the under side of the check-valve (49) than exists on the upper side (*i. e.*, a condition of "differential pressures.")

This is illustrated by the diagrams on the opposite page.

With the removal of portion X, of the partition between the passages for the flow of air from the auxiliary reservoir and from the train pipe, as shown in Fig. 1, the only possible *operation* of the structure is that of an *ordinary* "old-fashioned" triple, because the flow of auxiliary-reservoir air into the passage below the check valve will then be so rapid that the pressure on the lower side of the check valve will prevent its opening, notwithstanding the fact that the valve 41 has been fully

Diagram Illustrating the Necessity of a Partition with a Restricted Port, in the Triple Valve of Patent No. 360,070, to cause "Quick-Action".

Fig. 1.—Partition X Removed. Structure can operate only as an "Old-Fashioned" Triple Valve.

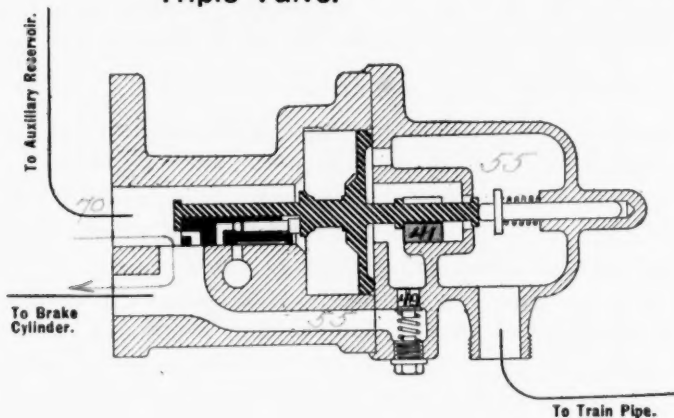


Fig. 2.—Partition X Inserted. Structure becomes a "Quick-Action" Triple Valve.

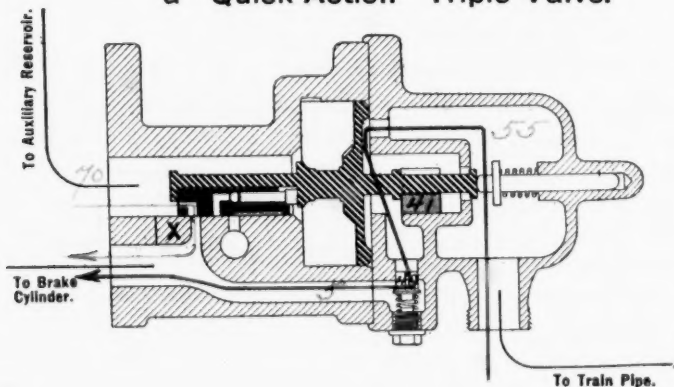


Diagram illustrating the Necessity of a
 Partition with a Restricted Port in the
 Triple Valve of Patent No. 360,070, to
 cause "Quick-Action"

Fig. 1-Partition X Removed. Structure can
 operate only as an "Old-Fashioned"
 Triple Valve.



Fig. 2-Partition X Inserted. Structure becomes
 a "Quick-Action" Triple Valve.



opened. The valve 41 and its port then become mere idle and useless parts.

But, with the portion X inserted (so as to provide only a *restricted* port for the flow of auxiliary reservoir air), as shown in Fig. 2, the structure becomes a "quick-action" structure, operating to produce "quick action" upon the extreme movement of the triple-valve piston, and the consequent opening of the emergency port, because pressure from the auxiliary reservoir is thereby choked or held back from the passage below the check valve, and the opening of the check valve (49) is then inevitable, because of the *differential pressures* on its opposite sides.

The experiment before the Court, therefore, when properly understood, does not prove that the Boyden valve differs in any substantial respect from the Westinghouse structure, nor that it operates in any substantially different mode. Nor does the fact that it operates by "differential pressures," and that its mode of operation can be changed from *auxiliary-reservoir air* admission (the "old-fashioned" method) to *train-pipe* air admission for quick action (the new method) by the insertion of the partition or ring 9, differentiate it from the Westinghouse structure, for that valve also operates through precisely the same causes, and it may also be changed from a "quick" action to an "old-fashioned triple" action by a similar simple removal of a restricted port in the partition between the air passages.

(d) These facts also refute another contention of the defense, that a partition containing a restricted port was *first invented* by Mr. Boyden. Such a partition, illustrated by the portion X, constitutes as vital a feature of the Westinghouse valve as it does of the Boyden valve. (See former Brief, p. 58.)

SECOND. A second proposition advanced by defendants' counsel, based upon the Court exhibition, was that a triple-

valve structure operates just as *quickly* and as *powerfully* when acting in the old-fashioned way, simply by admitting auxiliary-reservoir air, as does a Westinghouse "quick-action" valve, operating by the admission of train-pipe air.

The quicker *serial* application of the brakes, which results from the admission of train-pipe air, was *conceded*; but it was claimed that the Court could see for itself that the brakes were applied as quickly, on a single car, by the full application of auxiliary-reservoir air, as they were by the full application of auxiliary-reservoir air *plus* train-pipe air.

All such conclusions from the Court experiments would be very misleading.

The fact is that the application of the brakes by train-pipe air admission to the brake cylinder, in what is known as "quick action," by either the Westinghouse or Boyden valve, is not only *serially* more speedy, but is also *individually* both more speedy and more *powerful*.

This is, in substance, stated in the patent in suit (Patent, p. 787, fol. 1282). The patent states that the air discharged from the train pipe

"is utilized in the performance of preliminary work, it being found in practice that the air so taken from the pipe will exert a pressure of about twenty-five pounds in the brake cylinders."

From this statement, *greater quickness in reaching maximum pressure* and a *nearer approach to maximum pressure* are both necessarily deducible (as we shall next show), and this increased efficiency is proved, without contradiction, as an affirmative fact (*Westinghouse, Rec.*, p. 124, fol. 186).

While it is true that, under no circumstances, can the pressure in the brake cylinders (even in "quick action") be greater than the initial pressure in the main reservoir or in the auxiliary reservoirs (say 70 pounds to the square inch), yet this

statement does not touch the point now under consideration.* The problem was, and is, how *quickly* a *maximum* pressure can be reached by the filling of the brake cylinders with air under the *highest obtainable pressure*, and how near an approximation to the *maximum* pressure can be reached, notwithstanding the inevitable loss of *some* pressure in the act of *expanding into the brake cylinders*.

The Westinghouse quick-action valve of the patent in suit fills the brake cylinders with air under pressure (1) with *greater rapidity*, and (2) with a *nearer approximation* to the *maximum* pressure (70 pounds) than can be done from an auxiliary reservoir only, because,

FIRST. By its use, air under pressure is rushing in *both* from the train pipe and from the auxiliary reservoir, and the cylinders will, of course, fill faster with air under pressure when admitted *from two sources* than from one, other things being equal; and hence the brakes will apply quicker.

SECOND. The air in expanding into the brake cylinder necessarily loses a considerable proportion of its original pressure, because the same air has then to fill a much larger space, and necessarily loses pressure in expanding. It loses pressure in proportion to the expansion.

If, however, *train-pipe* air is rushing into the brake cylinder simultaneously with, or in advance of, the auxiliary reservoir air, and if it contributes *also* to fill the cylinder (exerting,

*The opinion of the Circuit Court of Appeals, at page 875, quotes a remark made in oral argument by one of complainant's counsel to the effect that "quick action" does not involve *greater* power. This remark is true in the sense that no greater power can be exerted *than that in the main reservoir or in the auxiliary reservoir*; but is inaccurate (for the reasons above given), if understood to mean that there is no greater pressure *at the brakes*, when *both* "train pipe" air *and* "auxiliary reservoir" air are utilized, than is the case when "auxiliary reservoir air" *only* is admitted. The contrary is proved and is the fact.

say, 25 pounds of pressure—Patent, p. 787), it is clear that it, to that extent, lessens the degree of expansion, and consequent loss of pressure by expansion, of the auxiliary reservoir air, which would otherwise occur. The *ultimate pressure* in the brake cylinder, and, consequently, upon the brake shoes, will be considerably greater if train-pipe air has been first injected, than if auxiliary reservoir air *alone* was employed.

This reduction of pressure, in expanding from the auxiliary reservoir, is incidentally adverted to several times in the proofs (Record, p. 317, fol. 488 ; 320, fol. 493), although the explanation above given is not found at length in the record. The fact of the existence of both *greater* and *more quickly-attained* pressure, due to train pipe "quick action," was never, however, disputed.

THIRD. As already noted in our previous brief (p. 15), it is not practical "for constructive reasons," to have the opening from auxiliary reservoir to brake cylinder a large one ; hence the brakes were never applied by the "old-fashioned" triple nearly so quickly, by auxiliary-reservoir pressure, as they can be, *and are*, in "quick action", by adding train-pipe pressure also, as utilized in the valve of the patent in suit.

FOURTH. Even though a large opening should be made from auxiliary reservoir to brake cylinder, in the case of a *single* individual triple valve (which was all that was shown in the Court experiments), yet no such large opening can be *thrown wide open* in actual practice, where a *number* of "old-fashioned" triple valves are arranged serially upon a long train. Each succeeding valve would open to a less extent than the one ahead of it in the train, and, while quick *individual* action might be had upon the *first* car, slow individual action only could be obtained upon the last cars. The making of a *large* aperture, which would open *fully* on the front cars, while only small apertures can be opened on the rear cars, would

intensify the disastrous shocks beyond anything which was ever found to exist where a small aperture from the auxiliary reservoir was used on all the cars. Hence, *small* apertures in the valves on *all* cars was the only practical construction.

This is fully explained by Mr. Westinghouse (Record, pp. 317-320), and is undenied.

The Court experiments, therefore, being with a single valve, only, and a single brake cylinder, necessarily failed to demonstrate that equally quick and equally powerful action could be practically obtained from auxiliary-reservoir air pressure alone as by the method of the patent in suit.

III.

The prior state of the art in emergency application of Brakes.

Mr. Hill's description of "development of the triple valve," pages 8-10 of his brief, seems to involve an effort to make it appear that "quick action", or "emergency" application, was not a new thing in air brakes at the date of the present invention.

Defendant's position herein is briefly replied to in our original brief, page 115. A word or two more may be admissible for greater clearness.

"Quick action", as we now understand the term, was absolutely unknown prior to 1886.

The only emergency action provided for or contemplated in the patents thus referred to by Mr. Hill, or to be found anywhere in the prior art, was that which resulted from the use in emergencies of a *slightly* larger port to the brake cylinder, for air from the *auxiliary reservoir*, than in graduating use.

As already explained, and for "structural reasons," in ordi-

nary service use, air was admitted *slowly* or in *limited quantities*, and could not be admitted otherwise from auxiliary reservoirs. When it was desired to stop the train in the presence of danger, the admission of air was *somewhat more rapid*; but—and this is the important point herein—the air thus admitted, for what is *alleged* to have been “quick action”, could not be admitted *in bulk*, and *was the same air* as was admitted in service use or in graduating; that is, it came, in both cases, from *the same auxiliary reservoir* and not from any other source. This obviously involved only a matter of *degree* and not a difference in *kind*.

This is admitted by Mr. Hill in his brief, in the middle paragraph of page 6. Speaking of the several valves of 220,556 (one of which, he says, in the previous paragraph, is “for an emergency”), he adds that they “perform the same kind of function and differ only in the *degree* or manner of performance.”

From this it will be obvious that, when Mr. Westinghouse provided for augmenting or supplementing auxiliary-reservoir air—the *only air previously used*—by taking air *from the train pipe* and charging it into the brake cylinder, by a *large and direct* port, he made an improvement which was different not merely in *degree* but also in *kind*.

How vitally important this change was, we have already shown.

Hence the “quick action” or “emergency” feature of the invention, now in question, is a radically different thing from the “quick action” or “emergency” previously known in the art, and on which so much stress seems to be laid in defendant’s brief.

Mr. Hill, in his brief, under the head “Triple Valve Defective on Long Trains” (pp. 12, 13), has very happily stated and explained the fact that, though a double-traverse piston had been previously used in the automatic brakes of short trains in passenger service, the second or further traverse was

wholly impracticable when the same apparatus was applied to long trains.

It necessarily follows, as a corollary, from this that when Mr. Westinghouse adapted the double traverse feature to the requirements of long trains, *he did something more than merely retain, without change of function, this old double traverse.* Combining it with the means which he devised for charging *train-pipe* air into the brake cylinder, he gave it a new function and a new operation. Hence, in this case, the merit of the invention does not rest solely on the devising of a system of apparatus for supplementing *auxiliary-reservoir* air by *train-pipe* air, but Mr. Westinghouse's merit as inventor is still further enhanced by his *ability* to utilize, and by his *success in utilizing* the "*farther traverse*" of the triple valve piston to do work which it never did before, and to do that work in a place where, as previously organized, it was incapable of being used.

Mr. Hill's brief deals, *also*, with the subject of quicker action by locally venting the train pipe, on pages 14 and 15. He cites a statement from Westinghouse Patent No. 217,838, dated July 22, 1879, as tending to show that the *mere* local venting of a train pipe at intervals along the train was not new.

Patent No. 217,838 is dealt with on pages 110-112 of our principal brief, and it is there shown :

FIRST. That Judge MORRIS distinctly held that this patent not only did not solve the problem of "quick action," but did not take the first really practical step in the direction of practically solving it.

This ruling was not questioned by the Boyden Company on the appeal, nor was any finding conflicting with it made by the Circuit Court of Appeals. On the contrary, that Court distinctly held (p. 880) that the invention of Westinghouse, although defectively claimed (in its opinion), "is one of the

highest value to the public, and *is a pioneer one in the art of quick-action brakes*," and the invention is "conspicuously one of those pioneer inventions which entitle the proprietor to a liberal protection from the Court in construing the claim."

SECOND. The mechanism of Patent No. 217,838 was absolutely inoperative and worthless for practical use.

See Evidence cited on p. 111 of our Principal Brief.

THIRD. Boyden himself admitted that such devices were not practically operative to be used in service (Former Brief, p. 111).

The primary and pioneer character of the present invention of Westinghouse is not impaired by an *unsuccessful attempt* of the same inventor, many years previously, to accomplish a *portion* of the same results.

In fact, the conclusion to be drawn from Westinghouse's unsuccessful attempt, seven or eight years earlier, is favorable, rather than unfavorable, to the pioneer character of his claims, when considered in connection with the present invention.

That Westinghouse himself had before attempted to solve the problem, and had failed to do it, is a high tribute to the importance of the present invention and to the difficulty of solving the problem which was solved by the invention of the patent in suit.

The greater individual efficiency of the brakes, combined with *greater rapidity in serial application*, and all under the control of the engineer, so that the apparatus was capable of the most delicate, as well as full, action in service work, and also the most energetic and powerful action in emergency work, was a problem which *had not even been attacked* until it was attacked by Westinghouse.

It has been said that nothing so strengthens the presumption in favor of a patent as an unsuccessful attempt to over-

throw it (*Sargent vs. Seagrave*, 2 Curt., 553); and it may also be said that nothing is more pertinent, upon the question of the essential novelty and utility of a patent, than earlier and unsuccessful efforts to accomplish similar results, which efforts have been abandoned or have never gone into practical use, and which even the defendant, who relies upon them, cannot assert are now practical.

IV.

The Scope of the Patent in Suit.

Mr. Hill, in his able brief, on page 23, discusses this question under the heading "*What is 360,070 entitled to cover?*" He states that the patent is not entitled to cover *merely* the prevention of shocks, nor *merely* local venting of the train pipe, nor *merely* the utilization of the extreme traverse of the triple-valve piston for another purpose (viz., the admission of reservoir air).

But none of these things, *in themselves*, are claimed in the patent in suit, nor has there been any effort to claim or cover them.

Mr. Hill then goes on to state what, in his opinion, the patent *is* entitled to cover. He says (p. 23):

"It was entitled, however, to cover a mechanical device; namely, the auxiliary valve 41 governing the special by-passage leading directly from the train pipe to the brake cylinder."

And, again (*Id.*):

"In other words, Patent 360,070, while not solving the problem of quick action, furnished for its subsequent solution by Mr. Westinghouse an important *factor*, consisting of the auxiliary valve and its by-passage, arranged to be put into action by the extreme traverse of the triple-valve piston. This Patent, 360,070, did not itself accomplish the desired result;

but it furnished an *element* for the subsequent combination by which Mr. Westinghouse finally achieved that result. *It should be construed, therefore, as a patent for that element or factor, broadly, and for nothing more.*"

(The italics are Mr. Hill's.)

Mr. Hill, in this and other passages throughout the brief, concedes what is undisputed ; that is, the pioneer character of Westinghouse's invention. Indeed, no contention has ever been made that the Westinghouse claims are not entirely valid, so far as novelty is concerned. The only question raised against any of them (in the line of validity) is the attack upon the second claim, due to its alleged defectiveness of form.

If Mr. Westinghouse was, as he is thus conceded to have been, the first person who ever constructed a brake apparatus in which a triple-valve device was provided with an auxiliary valve governing a passage leading directly from the train pipe to the brake cylinder, and if, as is also conceded, he accomplished thereby a perfectly novel and highly valuable result, why, in the name of common sense, and of the uniform rule of construction of patents of this character, should he be limited, as Mr. Hill claims, to "*the* auxiliary valve 41," or to "a special *by*-passage."

Is not Mr. Westinghouse entitled, also, to cover all combinations which are the equivalent of his, even though the forms of the individual parts may widely vary from his forms ? Is he not so entitled at least as much as any other inventor, and more so than most inventors ?

Did the essential novelty of his invention rest in "*the*" valve 41, or in its particular location in the structure, or in its particular shape ? On the contrary, was not the invention broader than that ; to wit, the combination, with a triple-valve structure, of an emergency valve which should open a direct passage from train pipe to brake cylinder when the valve structure is subjected to a rapid reduction of pressure, as described ?

Why is Mr. Westinghouse to be limited to a *particular passage* for the train-pipe air; or why must he be limited, still more closely, to a special *by*-passage for such air?

Did his invention lie in the special character or location of such passage?

We think not.

In *Western Electric Co., La Rue*, 139 U. S., 601, this Court took occasion to say, in overruling a narrow and limited construction of a patent for a useful invention:

"Since the case of *Winans vs. Denmead* (14 Howard, 330) it has been settled doctrine of this Court, as expressed in the opinion of Mr. Justice CURTIS, page 343, that, the patentee having described his invention, and shown its principle, and claimed it in that form which most perfectly embodies it, is, in contemplation of law, deemed to claim every form in which his invention may be copied, unless he manifests an intention to disclaim some of those forms."

The same case of *Winans vs. Denmead* contains the following statement:

"Where form and substance are inseparable, it is enough to look at the form only. Where they are separable—where the whole substance of the invention may be copied in a different form—it is the duty of courts and juries to look through the form for the substance of the invention: for that which entitled the inventor to his patent, and which the patent was designed to secure. Where that is found, there is an infringement; and it is not a defense that it is embodied in a form not described and in terms claimed by the patentee."

To the same effect is the opinion of this Court in *Machine Co. vs. Murphy*, 97 U. S., p. 120, cited on our previous brief (p. 52).

The pioneership of the patent in suit is expressly admitted by Mr. Hill in his brief, on page 52, as follows:

"Tested by this rule, the patent in suit, 360,070, was pioneer as to the auxiliary valve 41 and its *by*-passage, covering them and their mechanical equivalents, in whatever form they may be used."

As we have clearly shown, in our previous brief, that the de-

fendant's structure contains an "auxiliary valve" (22), and that the function of that valve is to admit *train-pipe air* direct to the brake cylinder, by being pulled off its seat by the extreme traverse of the triple-valve piston, and that the defendants' structure also contains the other prerequisite, viz., the preliminary traverse of the piston, which, through *another valve (i j k)*, admits air from the auxiliary reservoir to the brake cylinder, for service use, it is clear that this statement of Mr. Hill's is sufficient to cover the case of the defendants' structure, unless too much stress be laid upon his phrase "*by-passage*."

The defendants' passage from train pipe to brake cylinder is a *through* passage, instead of a *by-passage*, but, perhaps, on this account, it is all the more a *direct* passage, which is the only essential characteristic of the passage referred to in the Westinghouse claim.

V.

The Position of the Court of Appeals.

In discussing the question of infringement, the Court of Appeals in the present case (at foot of page 881) used the following argument, as negating infringement by the Boyden structure:

"But Boyden simply substituted in the original triple valve his poppet valve 22 for the slide valve which is the main valve of Patent 220,556. Boyden's is not an 'auxiliary' valve; it is mechanically the original main valve of the original triple valve, and it performs the service which is performed by the main valve of 220,556. It is not the mechanical equivalent of valve four in the attached apparatus of Westinghouse simply by reason of its taking part in an emergency service in admitting train-pipe air into the brake cylinder; in the original triple valve it performed no other service than admitting auxiliary reservoir air into the brake cylinder; in Boyden's device it

continues to perform that service, and is made incidentally instrumental in allowing the passage of train-pipe air. The performance incidentally of quick-action service does not make it an auxiliary valve. It is the same valve. The incidental service is auxiliary, but the valve itself is the same and unchanged."

Here is a singular misapprehension of fact, and, as we submit, of law also.

FIRST. *As to the fact.*

As already shown, valve 22, when the Boyden structure is complete, and the partition 9 in its place, does not admit auxiliary reservoir air to any practical extent, nor does it perform any function of a "main valve" (as that term has always been used in the art) to any appreciable extent, and especially on long trains.

This was, in substance, held by Judge MORRIS (Rec., p. 844, fol. 1365), it was admitted by Boyden (Rec., pp. 578-9, x-Qs. 214-216), and is a physical necessity from the construction of the apparatus.

Valve *i, j, k*, does all the "main-valve" work until main-valve work is no longer necessary to be done, because the brake-cylinder is practically full.

After that, it is possible that, by very careful manipulation, valve 22 may be opened to admit from three to five per cent. more air. But by that time the brakes are "on" with practically maximum force, and the train is so nearly stopped that so small a percentage of increase at that time cuts no appreciable figure in train control. That such increase, small as it is, ever takes place in *practice* is denied, and that it ever can take place at all, *except on short trains*, is not even asserted.

On the other hand, the recognized, admitted, prominent and *useful* function of valve 22 is to admit *train-pipe* air directly to the brake-cylinder, when pulled off its seat by the extreme traverse of the triple-valve piston, and it does that work as auxiliary to the valve, *i, j, k*, which is utilized for

"almost, if not all" admissions of auxiliary reservoir air, in service work.

How the Court of Appeals could then term this "quick-action" operation a mere "incidental" performance, it is difficult to understand.

It is the primary and only really useful service or performance for which the valve exists.

These points are elaborated on pages 38-48 of our former brief.

SECOND. As to the law :

Has it ever been heard that a party may infringe a patent by doing it "incidentally?"

If the combination of apparatus in the defendants' structure is substantially the same, as to its parts and its essential mode of operation, is it any answer to call the service which it performs, and by which it is identified as to its similarity to the patented apparatus, an "incidental" service."

We think not, and we think that no decision of this or any other Court will be found which will make this a governing consideration.

VI.

The contention as to the alleged invalidity of the second claim of Patent No. 360,070.

This has been discussed on pages 79 to 82 of our former brief, and we think it does not need much further consideration.

The able and ingenious brief of Mr. Church, filed on the former argument, is not sound in its comparison of the second

claim of the patent in suit with the eighth claim of the Morse Patent.

The Morse eighth claim (15 How., 112) was, baldly, obviously and expressly, a claim for the communication of intelligible signals at any distance by the use of the electric current, "however developed," absolutely irrespective of the use of any particular mechanism.

The second claim of Patent No. 360,070 bears no fair comparison with Morse's eighth claim. It reads as follows (with two obvious insertions):

"In a brake mechanism, the combination of a main air-pipe, an auxiliary reservoir, a brake-cylinder, and a triple valve having a piston whose preliminary traverse [*by opening a port*] admits air from the auxiliary reservoir to the brake cylinder, and which by a further traverse [*by opening a port*], admits air directly from the main air-pipe to the brake cylinder, substantially as set forth."

We have inserted in the phraseology of the claim the two parenthetical statements "*[by opening a port,]*" because they are necessarily and obviously implied in the language actually used.

Air under pressure cannot possibly be admitted from one chamber, or reservoir, to another, *except by opening a port*.

To insert the words, or to leave them out, therefore, neither adds to nor subtracts from the claim. If the claim is not open to objection with these words *inserted*, then it is not open to objection with the words *omitted*, because they are necessarily implied.

Of course, the claim is not limited to any particular special or *connecting* mechanism, by and through which the triple-valve piston acts to open, or "controls," the port which admits the air.

This is, in effect, conceded by the defendants themselves, when they concede (as they do in their brief) that the valve of the New York Air Brake Co. (see p. 34 of Mr. Hill's brief)

embodies the substance of this second claim, although the connection between, and control over, the emergency valve by the triple-valve piston is absolutely and entirely different from that illustrated in the patent in suit, and involves a separate and subordinate, although important, invention.

In admitting therefore—as the truth, of course, compels them to admit—that the valve of the New York Air Brake Company (illustrated opposite p. 34 of their brief) was correctly held to be an infringement of the second claim of the patent in suit, they impliedly admit that that claim was not, and is not, limited to any special mechanism by and through which the triple-valve piston controls or opens the emergency port.

Hence, on the defendant's own admission, the second claim is not fatally defective, through omitting to specify the special connecting means; and, as every other element is expressly or implicitly stated in the claim, there can be no sound contention that the second claim is invalid for lack of specifying the means.

Mr. Hill also attempts to make the same point, in the following extract (p. 29) from his brief:

“The expression ‘whose preliminary traverse admits air from the auxiliary reservoir to the brake cylinder, and which by a further traverse admits air from the main air pipe to the brake cylinder,’ is simply the expression of a *result*.”

And therefore, as he alleges, is obnoxious to the doctrine of *Morse vs. O'Reilly*.

This is hardly correct. The *result* is the stopping of the train. The passage thus quoted is a specification of the *operation* by which the *result* is secured.

VII.

The criticism upon Judge Morris' decision sustaining the charge of infringement.

We think the Court of Appeals erred in its interpretation of the language used by Judge MORRIS, in holding that the Boyden structure infringed the second claim of the Patent No. 360,070.

While the reasons for the conclusions of the learned Judge might, perhaps, have been more happily expressed, we think that the meaning thereof is clear, and that, when correctly understood, his position is not justly subject to the criticism made upon it.

The foundation of what Judge MORRIS said was this (p. 848) :

" If the Westinghouse Patent now in suit is for an invention of a primary character, and *if the gist of that invention is the use of the further traverse of the triple valve piston to open a valve which admits air directly from the train-pipe to the brake cylinder, with the result that the train-pipe is vented and the train-pipe air utilized*, then it appears to me that the defendant cannot exculpate itself from the charge of infringement by the fact that in its device the train-pipe air is admitted through the triple valve chamber and not through a by-passage, nor by the fact that, in its device, the further traverse of the piston opens the main valve in a special manner, which produces the same result, but does not make use of a separate auxiliary valve, provided Westinghouse has not, by the explicit terms of his claim 2, restricted himself to the use of an auxiliary valve.

" I do not think that Westinghouse has so restricted himself in claim 2, although he does appear to have done so in claims 1 and 4." (Italics ours.)

We submit that Judge MORRIS was misled by the ingenuity of the defendants into making the statement that the valve 22 of the defendants' structure was not a separate auxiliary valve.

We say that he was misled, because at another part of his

opinion (p. 844, fol. 1365) he admitted that it was the valve *i j k* that

"probably in most cases does do the work of ordinary braking," and

"the main valve 22 becomes non-essential, or, *if* lifted off its seat, is *moved very gently*."

This shows that valve 22 is not in reality the "*main valve*;" that it is in truth and in fact a separate auxiliary valve and does auxiliary work, and that it was primarily and substantially exclusively intended to do "*quick-action*" work by admitting train-pipe air, and that only occasionally, by very careful manipulation, could it be made to do auxiliary-reservoir work in connection with the true "*main*" valve *i j k*.

Such being the case, we submit that Judge MORRIS, to be correct, should have held that the first and fourth claims, also, were infringed.

But, as Judge MORRIS well remarked, the *second* claim does not contain such specific language as the first claim as to the exact character of the valve which is to admit train-pipe air.

In that *second* claim it is not strictly required that such valve should be "*independent of the main valve*."

Hence, if it is such a valve, at all, as to do the work required by the claim, upon the extreme movement of the piston, and if there be another valve which admits auxiliary reservoir air upon the preliminary movement of the piston, the substance of the invention is found and the language of the second claim is satisfied.

But after clearly and correctly, as we submit, defining the gist of the invention, Judge MORRIS went on, at a subsequent part of his opinion, to use the language criticised.

In this paragraph Judge MORRIS (Opinion, p. 846) states that, in examining

"mechanisms actuated by air under pressure", in which "the transmission of power is not visible to the senses as plainly as when it is done by cranks and levers," * * *

“ the functions of the instrumentalities by which it operates are more important than their forms, and in judging of an infringement we are to direct our minds rather to functional equivalents than mechanical equivalents.”

In this there was no *real* error, although the language has been read as implying a conflict with recognized principles.

What the Judge plainly intended to say was that, where the instrumentalities through which mechanisms act, as in the case of air pressures, are invisible, the *functions* which the parts perform are a truer *indication of the essential character* of those mechanisms than are the mere visible mechanical forms, because the *mere mechanisms* are not the actual operative agencies for producing results, while the invisible air pressures are the true agencies. Hence, in comparing mechanisms operating by invisible air pressures, and in comparing the action of air pressures with one another, as made operative in different mechanisms, and in therefrom determining the real character of the mechanical parts, it is entirely correct to say that what those parts *do* (*i. e.*, their *function*) is really more important than their forms, in determining *equivalency*.

Properly understood, therefore, Judge MORRIS' statements of the points to which attention should be directed, in any inquiry of this kind, is not open to fair criticism.

The Sum Total of Defendants' Case.

Defendants' entire case is summed up in one italicised line of Mr. Hill's brief (p. 35), thus :

“ *In this [Boyden] device, no auxiliary valve or by-passage is employed.*”

If this one statement is erroneous, then defendants have no case.

1. The Boyden valve 22 is either *the* main valve or it is *not*. So much is clear.

2. If the Court will turn back to page 5 of Mr. Hill's brief, and to the skeleton drawing facing that page, it will be seen that the main valve, colored black, is there represented to be the valve which admits air from *the auxiliary reservoir* to the brake cylinder.

3. The proofs show—and it is not denied—that, in the graduating and service use of the Boyden apparatus, this work of admitting air from *the auxiliary reservoir* to the brake cylinder is done by the stem valve *i, j, k*, and that valve 22 does not, in such use, open at all until *substantially all* the work of braking is thus performed.

4. This being so, *i, j, k* is the Boyden "main valve," and the Boyden valve 22 is *something else*.

5. Being *something else*, and, in its action for emergency purposes, being *auxiliary* to the main valve *i, j, k*, it becomes an *auxiliary valve*. It *can* be nothing else.

As to what "auxiliary" means, see the first three lines of page 4 of Mr. Hill's brief. Apply this definition of Mr. Hill's to the Boyden valve 22, and it is clear that it is an *auxiliary* valve.

6. We believe that we have already made it clear that the Boyden air conduit F through his piston 16, and through the valve 22, is a *by*-passage—as much so as the Westinghouse. It goes "*by*" or past the auxiliary reservoir without charging train-pipe air into such reservoir, but conveys it *direct* to the brake cylinder.

Hence, it is submitted that defendants' case, as thus summed up in a single line by defendants' leading counsel, is based wholly on errors of fact and a misuse of names.

What Complainant's Said in the Court of Appeals.

Mr. Hill, in his brief (p. 30), makes some citations from our briefs in the Court of Appeals, as involving a *supposed* more limited view of the invention than that now presented in this Court. Such was no part of our view of the case then or now. Everything we then said of the Westinghouse invention we also said and now say of the Boyden valve. It has a "quick-action attachment, consisting of an air conduit or passageway, directly from the train-pipe connection to the brake cylinder."

Such "an air conduit or passageway" will be found in the Boyden triple valve, through the piston at F, through the side ports uncovered by the valve 26, and through the port uncovered by the valve 22, as illustrated by blue lines in Fig. 22, facing page 40 of our original brief.

And that air conduit or passageway goes "directly from the train-pipe connection to the brake cylinder."

And it has "a valve [22] to control it."

And in the broad, general sense of the term, it is an "*attachment*," as much so in one case as in the other.

In Westinghouse this "air conduit or passageway" is bored through the triple-valve *casing*; in Boyden it is bored through the triple-valve *piston and casing*.

We also said, and say yet, that this new quick-action feature or element was, in substance and effect, "another brake mechanism." So it is in the Boyden valve. For ordinary service use, the Boyden triple piston opens the stem-valve ports *i, j, k*, by the preliminary traverse of the piston, and thereby substantially all the work of ordinary braking is done. The additional brake mechanism, represented by the further traverse of the piston, by the passageway through it, and by the valve 22, are then inoperative and inert.

But when "quick action" is required, then *they*, as an *additional* brake apparatus, and auxiliary to the *service* apparatus, are brought into operation.

Hence, what we then said, being as true of Boyden as it is of Westinghouse, cannot be used as an admission that the Westinghouse claims here in controversy are to be limited otherwise than in accordance with their terms.

And this same comment applies to what Mr. Hill says under "Fourth," page 50.

And, as the same quotations are made by Mr. Fenton in his brief (p. 9), we make the same reply to him.

Two Inaccuracies.

BOYDEN 1883 PATENT: Of this, Mr. Hill says (p. 16) that, by it,

"compressed air could be transmitted directly from the train pipe to said valve chamber and thence to the brake cylinder, *to augment the pressure of the brakes.*" (Italics are ours.)

The exact facts in this regard are presented in our original brief (pp. 106, 107) by extracts from the testimony of Mr. Boyden himself. By comparing what Mr. Boyden says with what Mr. Hill says, the misleading character of the latter will be obvious.

PATENT OFFICE ACTION: The idea, not merely suggested, but positively asserted by Mr. Hill (p. 55), that the *ex parte* statements made by Mr. Boyden in the descriptive part of his specification, are "officially endorsed as true" by the Commissioner of Patents, "by granting the patent which contains them," etc., hardly does justice to Mr. Hill's knowledge either of law or of Patent Office practice.

And, as this includes one of our assignments of error in our application for a *certiorari*, we summed up the facts and the law with some fullness in our original brief (pp. 83-91);

and, in so far as what Mr. Hill says differs therefrom, we submit with confidence that he is in error.

We submit that the decree of the Circuit Court of Appeals should be reversed, and the cause remitted to the Circuit Court with directions to enter a decree for complainants on the *first*, *second* and *fourth* claims.

Respectfully submitted,

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Counsel for Complainant.



Supreme Court of the United States.

GEORGE WESTINGHOUSE, JR., ET AL.,
Appellants,

vs.

BOYDEN POWER BRAKE COMPANY ET AL.,
Respondents.

No. 116, October
Term, 1896.

Brief on Behalf of Appellants in Connection With the Memorandum of this Court of January 24th, 1898.

The Court has directed the attention of counsel upon this argument—

“ particularly to the inquiry whether, in view of the state of the art, including the patents to Westinghouse, the proceedings in the Patent Office, and its own terms, the patent sued on can be sustained as a patent for a process or method.”

In this brief, we discuss these questions chiefly, referring to our former briefs for more detailed consideration of all the various issues which have arisen.

We understand the memorandum to, in substance, suggest the inquiry whether the patent in suit (Westinghouse Patent No. 360,070) is one to which the rule formulated by this Court in *Morley Sewing Machine Co. vs. Lancaster*, 129 U. S., p. 263, is applicable.

This Court then said (p. 284) :

“ But in a pioneer patent, such as that of Morley, with the four claims in question, such as they are, *the special devices set forth by Morley are not necessary constituents of the claim.* * * * ”

And again (p. 277) :

“ The doctrine thus applicable to a machine patent is of a kindred character with that applied, in this country and in England, to a *patent for a process.* ”

This rule has been applied even to the extent of ignoring the literalism of claims, when the justice of the case so requires.

Hoyt vs. Horne, 145 U. S., 302.

We proceed to show :

- 1st. That Westinghouse's Patent in suit is a pioneer one ;
- 2d. That nothing in the prior art impairs the scope of its claims ;
- 3d. That the proceedings in the Patent Office do not limit it so as to permit the escape of the defendant.
- 4th. That the claims are so worded as to make the form of the special devices for carrying out the method of operation unessential ; and hence that the liberal rules governing a patent for a process are applicable.

First Point. *The Westinghouse Patent is a pioneer one.*

(a) The "result" achieved by Westinghouse in the patent in suit was new.

What was the "new result?"

The "NEW RESULT" was a NEW BRAKE HAVING A NEW MODE OF OPERATION AND NEW USES AND CAPACITIES.

The patent says (Rec., p. 782) :

"The object of my invention is to enable the application of brake shoes to car wheels by fluid pressure to be effected with *greater rapidity and effectiveness* than heretofore, more particularly in trains of considerable length, as well as to *economize compressed air* in the operation of braking *by utilizing in the brake cylinders the greater portion of the volume of air which in former practice was directly discharged into the atmosphere.*"

Mr. Westinghouse says (Record, p. 116) :

"The construction of 'quick-action' automatic brakes is such as to provide for *all of the requirements of service stopping* equally as well as those functions have heretofore been performed by the 'automatic' brake system, and they are *additionally arranged* so that when 'emergency' stops are made there is *practically no delay* in the *full* application of the brakes, and there is also a *considerable augmentation of power* as compared with that available in service applications."

"The features of *substantially instantaneous action and augmented power* in *emergency* applications constitute the distinguishing features of the quick-action automatic brake as compared with the ordinary automatic brake."

Mr. Barnes says of the feature of augmented force (Record, p. 405) :

"The great increase in safety that resulted from the use of quick action triple valves is apparent, as it was found impossible to use a plain triple valve with a forcible action on long trains."

Mr. Boyden (defendant's expert) says (p. 657):

"In making an application of the brakes (nota 'quick action'), the reservoir pressure would exert about 50 pounds on the piston in the brake cylinder, but when making a *quick* application of the brakes, there would be about ten pounds more exerted on the piston over that exerted from the auxiliary reservoir pressure alone, making in all about 60 pounds pressure."

Mr. Westinghouse says (p. 124):

"The effect of this modification" (discharging train-pipe air into the brake-cylinder) "was to cause a considerable amount of the pressure in the train pipe to pass into the brake cylinder, where it contributed to that regularly supplied by the auxiliary reservoir, augmenting the brake force fully twenty per cent. in emergency or quick-action applications."*

See, also, Newbury (p. 258, x-Q. 346):

"A. As before stated, the brake-cylinder pressure, when making a quick-action or emergency application, with the Westinghouse quick-action triple valve, is about 60 pounds, when main air or train-pipe pressure before the sudden reduction is 70 pounds, while, with the same apparatus, in making a service-stop application, the brake-cylinder pressure is about 50 pounds, with a train-pipe pressure at 70 pounds, as before stated."

The essential characteristics of the "new result" were, therefore, a new brake having combined (1) more rapid and more powerful individual action in emergencies; (2) more rapid serial action; (3) unaltered capacity for "service" work; and (4) a capacity for use,

* It will be observed that Mr. Westinghouse and Mr. Boyden both agree as to the amount of augmented force availed of in "quick action."

Mr. Boyden placed it at an addition of ten pounds to a normal pressure of fifty pounds, which is the same as twenty per cent.

The opinion of the Court of Appeals, at page 875, quotes a remark apparently made in oral argument by one of complainant's counsel to the effect that "quick action" does not involve greater power than "service" action. This remark is only true in the sense that no greater power can be exerted than that which is stored in the main reservoir (70 lb.), but is admittedly inaccurate (as shown by the evidence above) if understood to mean that there is no greater pressure in the brake-cylinders when both train-pipe and auxiliary-reservoir air are utilized. The contrary is the fact, as was fully illustrated by a practical experiment in this Court at the last hearing. The Court of Appeals were, perhaps, misled by an inaccurate remark of counsel.

or exclusion from use, as the engineer may determine under the varying requirements of train-control.

We do not mean that no *part* of this result had been attempted before, nor that suggestions looking *partially* in the required direction had not been made.

As in the case of all other long-desired results, there had been previous attempts.

Westinghouse himself, eight years before, had *tried* to accomplish a *small portion* of the result (by his Patent No. 217,838 of 1879).

We shall deal with this aspect of the case later on.

What we now assert (and it is absolutely uncontradicted) is that as a *practical matter* a "quick-action" brake suitable for use on heavy and long trains (both for emergencies and ordinary use) had never prior to Westinghouse's invention of the patent in suit (in 1887) been in fact produced by any one.

More than that, no one had even contemplated what the *whole* problem was, and even Westinghouse had only attempted to solve a *part* of that problem (by his Patent No. 217,838), and had *failed* in the attempt.

The Court of Appeals decided this when they said (p. 872) of the prior Patents Nos. 217,838 and 220,556 :

"The mechanism of the patents just named did not provide effectively for sudden emergencies, and therefore failed to meet a *great necessity of the service.*"

And Judge MORRIS said (p. 847) :

"It is true that in searching for some device which would give quick action, Westinghouse had, before the date of the patent in suit, conceived the idea that it might be accomplished by venting the train pipe at intervals along the train. He had tried having two or three vents at intervals in the length of the train controlled by electrical apparatus, and also had tried relief valves placed in pipe coupling of each car which would open to the atmosphere and vent the train pipe quickly in case of accident or other sudden release of pressure in the forward part of the train. This was shown in the Westinghouse Patent No. 217,838, July 22, 1879, *but neither of these attempts were successfully applied, and they did not solve the problem of quick action.*"

(b) Westinghouse's invention of the "quick-action" brake was a pioneer or fundamental one, because, as an actual fact, it "lay at the bottom of" (to use the words of this Court in *Cochrane vs. Deener*, 94 U. S., p. 780) the application of power brakes to long freight trains; and, as freight trains are practically always long, it may be said to have lain at the base of modern freight train brake equipment.

Mr. Westinghouse's "quick-action" brake was immediately adopted (p. 132, fol. 198), and, at the time the evidence was given, 125,000 brakes embodying this invention (principally in the improved form of Westinghouse Patent No. 376,837) had been supplied by the complainant company (p. 135, fol. 202), and it is safe to say that, at the present time, more than five hundred thousand freight cars, in the United States alone, are equipped with brakes which use (in the combination of the 1st claim) "an auxiliary valve" controlled by the triple-valve piston, for admitting train-pipe air for "quick-action" (1st claim), or which use (in the combination of the 2d claim)

"a triple valve having a piston which, by a preliminary traverse, admits air from the auxiliary reservoir to the brake-cylinder, and which, by a further traverse, admits air from the train-pipe directly to the brake-cylinder."

At the trials of the Westinghouse brake in suit, the distance in which a 50-car freight train, running at 20 miles per hour could be stopped was reduced to 200 feet, from a previously required distance of 350 feet with the best-known type of brake (Westinghouse, p. 134, fol. 201).

The invention has produced, also, a complete change in passenger car equipment.

Mr. Westinghouse says (Record, p. 132):

"The increased efficiency in train stopping, resulting from the improvements from the invention of the quick-action air-brake, has also been realized in *passenger car brakes*, and a passenger-train can be stopped in a distance from 25 per cent. to 40 per cent. less with the quick-action brakes than when the prior 'automatic' system was used. This important improvement has been taken

advantage of by the principal railroads of the country, and *most of the equipment has been changed from the old to the new type.*" *

See, also, Mr. Barnes' very full statement of the new and great results achieved (Record, p. 404, fols. 628-9).

He concludes as follows (p. 405) :

"With the plain brake, on twelve passenger cars equipped as prior to 1887, at a speed of 40 miles an hour, it required 862 feet to make a stop, while with 20 freight cars, equipped with quick-action triple valves, a stop was made in 459 feet. These results are the average of many experiments.

"With a fifty-car train, such as shown on the drawing, running at 20 miles an hour, it required 1,800 feet to make a stop with hand brakes, while, with the same cars, using the quick-action triple valves, a stop was made in 100 feet. The great increase in safety that resulted from the use of quick-action triple valves is apparent, as it was found impossible to use a plain triple valve with a forcible action on long trains."

Surely, then, within the rule of decided cases, Westinghouse was a pioneer in this new departure.

Such vital and important changes in a great industry arising from the introduction of an invention are characteristic of a "pioneer patent."

If the specific result is essentially new, it is not necessary, to constitute pioneership, that the industry as a whole should be created by the invention.

In *Morley vs. Lancaster* (129 U. S., p. 264), the new point of the invention was the automatic machine for sewing buttons of a particular kind (with heavy heads) on fabric (see p. 273).

In *Consolidated Safety Valve Co. vs. Valve Co.* (113 U. S., 157), the Richardson valve was not the first safety valve, but it was a "pioneer" because it relieved pressure without unduly reducing it.

* The universal equipment of *passenger* cars with the Westinghouse invention proves the great practical value of the *augmented force* and quickened *individual* action of the mechanism of the patent in suit, quite apart from quick *serial* action. No passenger trains are long enough to require the quickened serial action, yet the invention of the patent in suit has been universally applied to them. The very first form of "quick action" apparatus (that of the patent in suit) in which serial action, although quickened, was not sufficiently quickened to avoid disastrous shocks on very long trains was, therefore, adequate of itself to produce a "revolution" in *passenger* service.

In *Clough vs. Barker* (105 U. S., 106), the gas burner of Clough was not the first regulatable gas burner, but it was a pioneer because "Clough was the first person who applied a valve regulation of any kind to the combination to which he applied it."

In *Tilghman vs. Proctor* (102 U. S., 707), Tilghman was not the first person to produce fat acids and glycerine from fatty bodies, but he was a pioneer because he was the first to do it by the action of water at high temperature and pressure.

In *Proctor vs. Beemis*, 36 Ch. Div., 740 (cited in *Lancaster vs. Morley*) the patentee was not the first to automatically supply fuel at intervals to a fire, but he was a pioneer because he was the first to do so "by an intermittent radial action" similiar to the action of a human arm.

In *Winona vs. Deering*, 155 U. S., 286, Steward was not the first to add an adjuster for the butts of grain, but he was a pioneer because he was the "first to invent a *piroated extension* to a butt adjuster."

(c) Westinghouse's invention here in suit is not only a pioneer invention, or one which caused a "new departure" or "revolution" in air brake practice, but it is one which in some respects was admittedly out of the line of previous thought upon the subject. Westinghouse—like all others skilled in the air-brake art—was called upon, in 1887, to devise a brake which would meet the modern conditions of freight train practice, viz., the control by fluid pressure of very heavy and long trains pulled by very heavy locomotives.

No known brake was at that time adequate to meet these conditions (Barnes, pp. 404 and 628).

A brake which was both quicker in serial action from car to car, and also more powerful and quicker in action on individual cars, was required.

Westinghouse solved this new problem by a most surprising expedient. He accomplished *both ends by the same means*. He made a more powerful and quicker acting brake by suddenly discharging ("venting") into each brake cylinder, for emergency stops, the air at *reduced pressure* contained in the train pipe.

Judge MORRIS, in the Circuit Court, well characterized this as a "paradoxical and startling" method of solving the problem. He said (Record, p. 845):

"Now, although quick-action emergency brakes were being sought for, no one before Westinghouse had accomplished this result, and the means by which he accomplished it were entirely novel. Indeed, upon first impression, it is paradoxical and startling to find that, when a *sudden, quick and powerful* application of brakes is needed in the face of impending danger, it is to be obtained by a *sudden large release of the pressure* in the train pipe, to the extent of 15 or 20 pounds below that in the auxiliary reservoir, and that *by using this low pressure air* to operate the brake cylinder, instead of the air under greater pressure stored in the auxiliary reservoir, this remarkably effective application of the brakes is obtained."

And not only was this "*means*" of obtaining quick and powerful action—*i. e.*, by utilizing "train-pipe air" to fill the brake-cylinder—absolutely novel, but even the mechanical instrumentality by which this was done, to wit, utilizing the "further traverse" of the triple valve piston for that purpose, was also a startling and novel expedient, because it was utilizing the very feature which (as admitted by Mr. Hill in his first and principal brief, p. 12) *was the very cause of the impracticability* of quick action on long trains, with the best form of automatic brake previously known.

Mr. Hill then said (p. 12) in his history of the development of air-brakes:

"The triple-valve thus slowly evolved from the original form of Patent No. 141,685, August 12, 1873, to the highly improved form of Patent No. 220,556, October 14, 1879, and in the latter form used by the complainant without further material improvement until the year 1888, was satisfactory for short trains consisting of eight or ten cars or less, but on long trains consisting of forty or fifty cars or more, *it was not only unsatisfactory but absolutely impracticable; and its impracticability resulted from the very fact that the piston had the two traverses* referred to by Mr. H. H. Westinghouse, at the bottom of p. 123, namely, a partial traverse for graduating purposes, and a full traverse for emergency stops."

What can more surely indicate and characterize a fundamental invention than the two features thus admitted to be surprisingly novel, *viz.*, the use of "*low pressure*" train-pipe air to produce *quicker and more powerful* brake action than the higher pressure auxiliary

reservoir air, and the use of the *double* traverse of the piston as the governing feature of the mechanism for producing quick serial action, which had been the very cause why quick serial action, in the best form of prior brakes, had been "absolutely impracticable."

(c) But the pioneer or fundamental character of the Westinghouse invention was *not* only demonstrated by the fundamental change in freight and passenger brake equipment, and by the wide adoption of the invention, and by the surprising conversion of the very means which were the cause of prior failures into an element of success for accomplishing the purpose, but all the adjudications upon this patent have been to the same effect.

Thus Judge MORRIS said in the Circuit Court, in the present case (Record, p. 845) :

"In the domain of quick-action brakes, this device would seem to belong to that class of pioneer inventions the patents for which are to be construed so as to be co-extensive with the real invention, if the language of the claim will permit it."

And, again (p. 847) :

"The problem was not solved ; indeed, the first step in the direction of solving it does not appear to have been taken until the experiments which led to the Westinghouse patent now in suit."

And the Court of Appeals in the present case said (Record, p. 880) :

"That this invention of Westinghouse, thus undefined, is one of the highest value to the public, and that it is a pioneer one in the art of quick-action air brakes is not denied and is conceded. It is conspicuously one of those pioneer inventions which entitle the proprietor to a liberal protection from the courts in construing the claim."

And in the Second Circuit in the suit of *Westinghouse Co. vs. New York Co.* (63 F. R., 962), Judge LACOMBE, referring both to the patent in suit (No. 360,070) and its successor (No. 376,837), said :

"Both of these inventions achieved great necessities and overcame great hindrances ; each is an indispensable part of the bridge which carried railroad car builders from failure to success ; both were products of the inventive genius of the same man ; nothing anticipating either is shown.

* * * * *

"Although No. 360,070 was not declared upon in the earlier suit, it was discussed at great length and its meritoriousness was clearly recognized. The statement of the problem to be solved as it stood prior to January, 1888, and of the contribution of No. 360,070 to that solution, as they are set forth in the opinion above cited, leave no doubt that both the Circuit Court and the Circuit Court of Appeals regarded it as a patent of wide breadth."

Surely, in a case like the present, unless there be some controlling fact or principle of law which has been overlooked by all of the tribunals before whom this question has been in controversy, this is one of those cases of a "machine patent" in which, if the essential elements of the claims be found, the "special devices" set forth by the patentee "are not necessary constituents of the claim," and the rule of construction applicable to it "*is of a kindred character to that applied in this country and in England to a patent for a process*" (*Morley Co. vs. Lancaster*, 129 U. S., p. 263).

See, also,

McCormick vs. Talcott, 20 Howard, 402, 405.

The Barbed Wire Case, 143 U. S., 275.

McCormick Co. vs. Aultman (C. C. A.), 69 F. R., 371, 386.

Second Point. *Nothing in the prior art impairs the scope of the Westinghouse claims.*

Having now shown that, as a practical matter, the invention of Westinghouse here in suit was of a primary or pioneer character, because :

1st. The *result* achieved was new.

2d. It has been largely, if not universally, adopted.

3d. The *means* for producing the result, not only in detail but in general character, were new (viz., venting train-pipe air into the brake cylinder for emergencies, and for emergencies *only*).

4th. The novelty, both in the source of the air pressure and the mechanical means controlling its introduction (the *double* traverse of the piston), was not only novel, but was startlingly and paradoxically so.

We now proceed to consider more in detail the line of inquiry to which our attention has been directed by this Court.

Was there anything in the state of the art, or in what Westinghouse himself had previously done, which impairs the substantial novelty of the invention?

Two, and only two, references are cited in Mr. Hill's brief as having any bearing upon this branch of the case. These are :

(a) The Westinghouse Patent No. 217,838, and

(b) An alleged English patent of one Sanders of 1879 (see Mr. Hill's Reargument Brief, pp. 91, 92).

Neither of these have any importance in limiting Westinghouse's present invention.

A brief explanation will make this apparent.

What was the problem which had been so long before the constructors of railway brake apparatus, and which was solved by the Westinghouse Patent in 1887?

The object sought was to stop a heavy and long freight train *both* in a shorter distance *and* with a quicker serial action from car to car.

This was not a simple problem.

It must be borne in mind that it is not permissible to ordinarily use brakes of such power as to actually stop the rotation of the wheels and cause them to slide upon the track.

While that action may be allowed in great emergencies, where everything must be sacrificed to safety, yet no brake is a practical one which in ordinary use ("service" use) will be liable to produce a sliding of the wheels.

The great disadvantage of the use of brake pressure so great as to produce wheel-sliding has been referred to even in *hand-brake* litigations which have been before this and other courts for the last forty years.

Mr. Westinghouse says (p. 115) :

"To render the operation of brakes, in 'service' stopping, satisfactory and economical, the result of practice has determined that the *amount of braking power should be limited to a degree that will render it possible to operate the brakes without reasonable liability*

of locking the car wheels when in motion. Such a result is objectionable, as by means of it flat spots are worn in the periphery of the wheels, and they are rendered unfit for further service."

(See discussion of this subject by Judge DRUMMOND, in 1863, in *Emigh vs. C., B. & O. R. R.*, 1 Biss., 400, and by Judge MORRIS, in 1881, in *Emigh vs. B. & O. R. R. Co.*, 4 Hughes, 271; and, indirectly, *Railway Co. vs. Sayles*, 97 U. S., p. 554.)

In 1887, however, air brakes had long superseded hand brakes. They were introduced by Mr. Westinghouse twenty years ago or more, and the maximum permissible pressure in the auxiliary reservoir had long been established by practice at seventy pounds. That pressure, *when expanded* into the brake cylinders, produces an effective braking force, for service use, of fifty pounds to the square inch (Newbury, Rec., p. 24, and p. 258, x-Q. 34). Long practice has shown that no greater power than fifty pounds in the brake cylinder can be used in ordinary service operations with satisfactory results.

Now, when the problem of equipping long and heavy freight trains with air-brakes presented itself, and when the question arose as to how such trains were to be stopped, not only *more smoothly*, but in a *shorter distance*, when emergency application was required, the question presented itself of devising a brake which for "service" use *would not* and *could not* exert greater pressure than before, but which should have a capacity *in emergencies only* of acting quicker and with greater power.

As was said by this Court in *Consolidated Valve Co. vs. Crosby Co.*, 113 U. S., page 157:

"This was a problem of the reconciliation of antagonisms, which so often recurs in mechanics, and without which practically successful results are not attained."

The *ideal* brake system might have been understood to be one which should include two separate and distinct brakes; one, a brake of limited maximum power and gentle or moderate application, which would serve all the purposes of every-day operations without injury to the wheels and without jolt or discomfort to the passengers or lading; the other, a brake of materially greater maximum power and of sudden and violent application, held in reserve for use

only in cases of threatened disaster, whereby the train could be brought to a stop in the shortest possible distance. Mr. Westinghouse says on page 124 :

" In fact, theoretical considerations would suggest *two independent brakes of different degrees of power or force* ; one of them to be used *for service operations*, to be *limited in power* to a point that would render the locking of car wheels impossible ; the other to be used only *in emergency or quick stops*, and calculated *to exert a much greater force*, thereby overcoming the speed of the train *in the least possible time and distance*."

It was fully recognized by practical railroad men, however, that the difficulties and complications connected with the employment of *two different* brake systems upon the same train were practically insurmountable and prohibitory, and no attempt was therefore made to realize the advantages of such a double system.

It was suggested on the prior argument of this case, in this Court, that greater power might have been secured either by enlarging the auxiliary reservoir under each car, or by storing it with air under higher pressure, or by enlarging the brake cylinder, so as to apply pressure on a larger piston area.

These suggestions were made outside of the proofs, as there is nothing in the record to show that either of these expedients would meet the conditions which confronted the art.

As a matter of fact, consideration of each of these suggested solutions (and for this we must also go outside the record) will show that neither of them can possibly be practicable.

Increased auxiliary reservoir capacity and increased auxiliary reservoir pressure would necessarily increase the power applied at each full "service" application of the brakes, as well as in "quick action." Whatever the maximum brake cylinder pressure may be, *it is the fixed maximum for both service and emergency applications*. But increased pressure is not permissible in service use, without danger of wheel-sliding. If greater pressure were sought for and availed of in *emergency* application by enlargement of the auxiliary reservoir, such greater pressure would also be present in every full *service* application. This,

for the reasons above explained, is impracticable. The limit of pressure to be exerted in *service* applications had been fixed by probably more than twenty years of practice.

Nor would the expedient of enlarging the brake cylinder, so as to increase the area of pressure on the piston, be any more available. A large cylinder is one which, with a given inlet, fills more slowly, just in proportion to its size. A brake, therefore, which would be more powerful because of increased cylinder capacity, would be one which would be *too slow* in application.

Neither one, therefore, of the suggested expedients for solving the problem could, in the nature of things, have been possibly availed of, and there is no hint in the proofs that either of these suggested solutions was ever attempted, either before or since Westinghouse's invention of the patent in suit. In fact, for the reasons above given, they are wholly impracticable.

The problem was how to get quicker action and increased efficiency *with the same reservoir power*—the latter having already reached the maximum limit.

What was Westinghouse's solution?

As above noted, it was of a "startling and paradoxical nature." He did not produce two separate brake systems, but he made a *unitary contrivance with the functions and advantages of two*, and with *none of the complications* involved in the use of two.

He kept the automatic brake, so far as its "service" use was concerned (whether for full stopping or for graduating speed), absolutely intact in every function and mode of operation. It could be applied delicately or with full pressure at will, but it never exceeded the limit of practicable pressure (50 pounds to the square inch in the brake cylinder), without the distinct volition of the engineer in specially manipulating his valve at the engine.

But when an emergency arose, when the train was to be stopped at all hazards and in the shortest possible distance, and when wheel-sliding, with its attendant impairment of the rolling-stock, became of secondary importance, then the engineer possessed the power, and the apparatus which Westinghouse invented possessed

the new capacity of quicker and more powerful action, by the mere throwing wide and suddenly open the engineer's valve, and suddenly reducing the pressure in the train pipe by twenty pounds. By that means, a new port was opened and the air, at reduced pressure, was admitted through a larger aperture into the brake cylinder, thereby *rapidly* filling it, and thereby diminishing the space into which the auxiliary reservoir air, at its higher pressure, had to flow and expand, and thereby, by the use of *both* train pipe and auxiliary reservoir air, the brake cylinder was filled more quickly and with air at a higher pressure (because less reduced by expansion), and, by this same venting of the train-pipe air into the brake cylinder, he *also* simultaneously produced *quicken*ed serial action from car to car (*Newbury*, pp. 257-8, 9, 345 and 346; *Newbury*, p. 23; *Boyd*en, p. 657; *Westinghouse*, p. 124).

We submit that the invention which solved this great and complicated problem, produced this highly useful result, and produced it by such unexpected means, is entitled to every favorable construction which the rules of law permit.

Well did Judge MORRIS say of the prior art (*Record*, p. 847) :

"The problem was not solved; indeed, the first step in the direction of solving it does not appear to have been taken until the experiments which led to the Westinghouse Patent now in suit. The substance of the method then devised is the use of the sudden further traverse of the triple valve piston to open a valve in a manner different from the valve opening made by the preliminary traverse for service braking, thereby admitting train-pipe air to the brake cylinder without its passing through the auxiliary reservoir."

And again (p. 843) :

"The result which Westinghouse was seeking in the new device, described in Patent No. 360,070, was first and principally to vent the train-pipe air at each car so as to quicken the serial action of the brakes from car to car; and, secondarily, to utilize the vented air and not waste its power."

And the Court of Appeals described the object which Westinghouse (first) and the defendants (subsequently) attained in the following words (p. 875) :

"the *common object* being to produce a mechanism by which to secure instantaneously, whenever and *only* when a sudden emer-

gency arose, *such a quickened discharge of compressed air into the several brake-cylinders that each car would simultaneously, and the entire train as a whole, be brought to a sudden halt, but leaving the mechanism already existing for use in ordinary braking unmolested and unchanged.*"

Having thus explained the problem, let us now consider the references relied upon to impair the merit of Westinghouse's "quick-action" invention.

(a) *The Westinghouse Patent No. 217,838 (Record, p. 759).*

This patent undoubtedly suggests the desirability of quick serial action, and makes the statement that, to accomplish this, "it is only necessary to make provision for the simultaneous opening of one or more ports in the air-conduit passages at points not remote from each auxiliary reservoir."

The patent then says :

"For this purpose I arrange at such various parts of the air-conduit or communicating pipes as may be desired, but by preference at the couplings, relief valves of the kind shown in the drawings."

The trouble with this patent and its availability to the defense, in seeking to limit the scope of Westinghouse's claim, is that the patentee had only *half* conceived the problem, and did not provide a practical means for carrying out even that half which he had conceived.

He *thought* that it was "*only* necessary to make provision for the simultaneous opening of one or more ports in the air-conduit passages at points not remote from each auxiliary reservoir," and to do this by means of a "relief valve," such as he described and illustrated.

He was wholly in error even in this partial conception. "Only" doing what he described is valueless.

That way of dealing with the problem does not solve it.

Indeed, Mr. Boyden himself (the principal expert for the defendants) admitted this.

Boyden obtained permission from the Court to test certain valves (Rec., p. 663), and he thereupon tested, in presence of complainant's experts, certain valves which he *claimed* were like

those of Patent No. 217,838, but which he had to admit (Record, pp. 685-690) were *modified* in some particulars, not found in the patent nor apparent from the prior art (p. 685, x-Qs. 301-305).

And he then was compelled to admit (Rec., p. 692) as follows :

" 344 x-Q. Did the tests which you made with the device of Patent 217,838 demonstrate that said device was in any wise practically operative to admit air from the auxiliary reservoir to the brake cylinder by preliminary traverse of the triple-valve piston, and to admit air directly from the main air pipe to the brake cylinder by a further traverse of the triple-valve piston ?

" A. They did not.

" 345 x-Q. Did the tests which you made with the device of Patent 217,838 demonstrate that said device was practically operative to a degree sufficient to warrant you or any other capable air-brake constructor in advising its adoption in practical railway service ?

" A. The tests demonstrated that the device would quicken the action of the brakes ; and they demonstrated to my mind, as I think they would to any one who is skilled in air brakes, that the device of Patent 217,838 could be so arranged and modified to suit the automatic air brake as to make it just as efficient a brake as those now in general use, and one that could be recommended to railroad officials for practical use.

" 346 x-Q. (x-Q. 345 repeated.)

" A. The results produced by the devices of Patent 217,838, *as I tried them*, were not of an efficiency that would justify me in recommending the use of the devices to railroad officials.

" 347 x-Q. Did the tests which you made with the device of Patent 217,838 demonstrate that said device was practically operative to such a degree as to lead you to believe that it would be acceptable to, and accepted by, any competent railroad official for use in practical railroad air-brake service ?

" A. The tests I made with the device of Patent 217,838 demonstrates that the device, as I made them, was not practically operative to be used in service ; but they demonstrated that the device of Patent 217,838 *could be so modified* that it would practically be operative in railroad service. As to being able to get railroad officials to adopt it, that is something I cannot say, as I might be able, then again I might not."

And again (x-Q. 348) :

" A. My opinion is that the device, *as I used it*, would not be acceptable to railroad officials for practical use."

This Court, in *Topliff vs. Topliff*, 145 U. S., page 156, emphatically condemned any such method of endeavoring to anticipate a patent by "modifying" prior contrivances, saying :

"It is not sufficient to constitute anticipation that the device

relied upon might, by a modification, be made to accomplish the function performed by the patent in question, if it were not designed by its maker, nor adapted, nor actually used, for the performance of such functions."

Rebuttal to such evidence was hardly required, but, on the part of the complainant, Mr. Newbury testified on the subject of the operativeness of valve of No. 217,838, as follows (p. 189, Q. 223) :

"A. So far as I can see, the device of the said patent 217,838 is not adapted at all for practical operation in an automatic air-brake system, or, in other words, an attempt to incorporate such mechanism in an automatic air-brake system would simply destroy it and render it utterly worthless as such a system.

"Furthermore, the device shown and described in said patent 217,838 is wholly incapable for any practical use, unless it can be said that the destroying of an automatic air-brake system was practical use, as that is the only purpose which I can see that it would serve."

He then proceeds to give the reasons for this statement, which are wholly uncontradicted.

And Mr. Barnes (p. 405, Q. 699) said :

"A. It is not at all applicable, for the plain reason that it could not be used practically. Such a device so obstructs the feeding or charging process as to prevent its practical application to practical trains.

"It would be impossible to graduate the brakes in a service application, so as to make the necessary difference in the force of applying the brakes."

He then proceeds to give the reasons for these statements.

Mr. Westinghouse says (p. 830) :

"I did not find the devices made by Mr. Boyden to be in strict accordance with the instructions of patent 217,838, but, on the contrary, there were important and wide variations in those structures."

And again (p. 830) :

"A. I have been unable to find anything in the specification or drawings of the patent in question that would justify any departure from the usual practice of a skilled mechanic, in making a structure from the said drawings and specification."

And again (p. 834, Q. 904) :

"904 Q. Taking the valve device as you saw it experimented with, as changed and modified by Mr. Boyden in the particulars you have stated, and in view of the results produced by Mr. Boyden, what is your opinion as to the practical merit or value of said valve device for actual use in controlling freight trains on railroads?

"A. I agree with the opinion expressed by Mr. Boyden in answer to x-Q. 348, that the device, as he used it, would not be acceptable to railroad officials for practical use.

"905 Q. To what extent, if at all, would your opinion be modified if the valve device was constructed in strict accordance with Patent No. 217,838, instead of deviating therefrom, as used by Mr. Boyden, in the particulars you have specified?

"A. Not in any respect.

"906 Q. Mr. Boyden admits, in answer to x-Q. 305, that it is the fact that, long prior to the institution of this suit, he himself recognized the obvious practical inoperativeness of the device of Patent 217,838. To what extent do you concur on Mr. Boyden's recognition of the obvious practical inoperativeness of this device?

"A. I fully concur with him."

As to Patent No. 217,838, at least, therefore, the Court of Appeals and Judge MORRIS were entirely correct in their finding, viz., that it did not in any way solve the problem involved in "quick action"—*i. e.*, "quick action" serially and individually for emergency use, and unimpaired "service" action—and the more so because the proofs on both sides are to that effect.

(b) *The alleged English Patent of one Sanders, of 1879.*

Mr. Hill's brief of reargument contains the assertion (p. 91, foot of page):

"The fundamental law shown in the 1879 patent to Mr. Westinghouse was not first disclosed by him, as it was patented in England (R., p. 68, line 7), March 12, 1879, No. 980, by Sanders."

This is a somewhat unusual statement, for no patent to Sanders is in the record, either of March 12, 1879, or of any other date. Mr. Hill's reference to the record, at page 68, contains no mention of any patent to Sanders.* All that appears at the place in the record referred to is a statement by Mr. Newbury that a certain combination of devices, *not* organized to produce "quick action," but for some other different purpose, is found in "British Letters Patent of about the year 1879."

* Although there is no patent of Sanders in the record, we have no objection to saying that a Sanders Patent exists, although we should expect to show, if opportunity offered, that it is not like Westinghouse's, and that it has been fully considered and overruled in other litigations.

Of course it should not have been referred to (*Preston vs. Prather*, 137 U. S., 604).

There is in the record a British Patent of 1879 to Barker (Record, p. 473), and to this, doubtless, Mr. Newbury referred. This patent shows an automatic air-brake mechanism, with the elements named in the questions to Mr. Newbury, but *not so* organized and arranged as by any possibility to produce "quick action," and no one pretends that that apparatus has, or could have, any such effect. No one on behalf of the defendants so contends. The purpose and operation of the Barker apparatus is fully explained on page 476 of the record, and is an entirely different one.

We may conclude, then, in answer to the first branch of the inquiry suggested by this Court, that there is nothing in the state of the art, including the patents to Westinghouse, which impairs the scope of the patent in suit.

Third Point. *We next inquire whether the proceedings in the Patent Office have any effect in limiting the scope of the patent in suit.*

What were the proceedings in the Patent Office?

They appear by the file wrapper of his original application (Record, p. 714).

The patentee presented as the form of his first claim the following :

" 1. In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake cylinder and a triple valve provided with a device for admitting air directly from the main air pipe to the brake cylinder, substantially as set forth."

The second claim was originally presented in the precise form in which it was finally patented as follows :

" 2. In a brake mechanism, the combination of a main air pipe, an auxiliary reservoir, a brake cylinder, and a triple valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake cylinder, and which, by a further traverse, admits air directly from the main air pipe to the brake cylinder, substantially as set forth."

The Patent Office, on January 14, 1887 (Record, p. 717), alleged that claims 1 and 2 were anticipated by the Boyden Patent No. 280,285, of 1883.

The patentee thereupon, under date of January 19, 1887 (Rec-

ord, pp. 717, 719), amended his first claim to the form in which it was patented, retaining the second claim unaltered, and filed an argument showing that the Boyden invention had nothing whatever to do with the problem of "quick-action."

The claims were subsequently allowed.

When it is remembered, as Judge MORRIS said (Rec., p. 849), "*what was the real invention*," it will be apparent that the amended first claim, which Westinghouse filed as substitute for that first presented, had no limiting effect upon the scope of the patent, and certainly had none upon the second claim, *which was not altered at all*.

The gist of the invention lay in the combination by which the triple valve, *with all of its functions for service use retained*, was supplemented by a port, controlled by the triple-valve piston which in emergency use (and *only* then) was opened for the admission of train-pipe air to the brake cylinder to produce "quick action."

The first claim of the patent, *as originally presented*, did not "particularly point out," as the statute required (R. S., Sec. 4888), this fundamental feature of the invention. It was so phrased as *seemingly* to include an apparatus which was "provided with a (*i. e.*, any) device for admitting air directly from the main air pipe to the brake cylinder," irrespective of the purposes and conditions by and under which said admission was effected.

Hence the Boyden Patent of 1883 was cited by the Patent Office, not because that patent describes a "quick action" brake, nor one which has the remotest effect in limiting the *real* invention of Westinghouse, but solely because it happened to have a passage from train pipe to cylinder in a *different* combination and for an entirely *different purpose*, to wit (p. 776): "for replenishing, *while the brake is on*, the air reservoir on each car, or the brake cylinder when the pressure therein has been *lessened by leakage*."

Now, nothing could be more unlike Westinghouse's "quick action" apparatus in operation, purpose and result than this device of Boyden's.

Hence the attorney, when the inaccuracy of the original wording had been pointed out, amended the first claim so as to clearly distinguish Westinghouse's apparatus from that of Boyden's of 1883, and satisfied the Patent Office that the Boyden apparatus of 1883 had no pertinency whatever in connection with the second claim, which was thereupon allowed.

That the Boyden Patent of 1883 had no relation to "quick action" is admitted by Boyden himself. He said (Record, p. 497, Q. 8) :

"I wish to state here that my 1883 patent was not for a 'quick-action' valve (as that term is now understood)."

And, again (Record, p. 574, x-Q. 195) :

"In the triple valve of Patent 280,285 *no application whatever* of the brakes is effected by the passage of main air pipe air to the brake cylinder, and no main air pipe air is admitted to the brake cylinder until *after* the brakes have been applied, with the maximum rapidity and force within the capacity of the device, *by auxiliary reservoir air alone.*"

And again, on cross-examination, he says :

"I did not wish to imply, nor do I now, that my 1883 patent was for a quick-action valve such as you have stated."

Judge MORRIS found, as a matter of fact, that, as between the Boyden Patent of 1883 and the patent in suit,

"There seems to be no analogy or comparison that can be made between them."

And this ruling was not disturbed by the Court of Appeals.

In the matter of amending the *claims*, there was, therefore, no limitation of the scope of the real invention, but only a more clearly defined statement of that invention as compared with one which had no real relation to it.

The terms of a patent claim are in the nature of the metes and bounds of a deed for land, in that they define the limits of the grant. If the metes and bounds of an original deed, or of an application for a land grant, include more than the grantor could give, and more than the grantee intended to ask for, the metes and bounds must be corrected and limited, but—and this is the rule the benefit of which we invoke—*everything within the corrected metes and bounds belongs to the grantee.*

In formulating the amended first claim all the metes and bounds remained as before, unaltered and unchanged, except one. For "a device," of any kind—which gave a boundary line of too large an extent because it included something which was not "Quick Action"—there was substituted, as respects *that* claim, a new boundary line, which is thus defined:

"an auxiliary valve device, actuated by the piston of the triple valve, and independent of the main valve thereof."

We have shown, as we believe, in our original brief (pp. 38-79), that defendants' quick-action apparatus comes inside or within the correctly stated boundary line thus delineated.

Its "auxiliary valve device" is the valve 22. It is "actuated by the piston (29) of the triple valve," and is "independent of the main valve"—a "*service*" valve, *i j k*.

(For further discussion of this point see our original brief, pp. 91, 92.)

Another amendment to the specification was that embodied in the amendment of January 19, 1887 (Record, p. 720). In that amendment applicant stated as follows:

"I am aware that a construction in which 'an always open one-way passage' from the main air pipe to the brake cylinder is uncovered by the piston of the triple valve simultaneously with the opening of the passage from the auxiliary reservoir to the brake cylinder has been heretofore proposed."

He thereupon disclaimed that construction as one which involved an operation different from that of his invention.

This "disclaimer" was rather in the nature of an *explanation* than a true disclaimer. It pointed out that the use of an "always open one-way" passage was an entirely different thing from the patentee's construction, in which the passage or port from the train pipe to brake cylinder is *not* "always open one way," but is never open operatively except when it is forcibly opened for an emergency application of the brakes.

Surely here was no limitation of the real invention, nor any impairment of the proper scope of the claims.

The defendants' port under valve 22 is *not* "always open," but is open (at least for effective purposes) *only* in emergencies.

Nor was the argument of the applicant's attorney (Record, pp. 718, 819) one which can be used in the interest of an infringer to narrow the scope of the claims. The whole purpose of that argument was a simple and a single one. It was intended to point out that the Boyden Patent of 1883 had no relevancy whatever to the real invention of Westinghouse, and such was the fact, as it is now conceded by Mr. Boyden.

This Court will not, we believe, impair the just scope and control of the claims for a valuable invention, on any strained construction of the phraseology of the attorney for the applicant, used in the course of showing how totally different Westinghouse's invention was to that of the prior Boyden Patent, which, it is admitted, taught nothing on the subject of "quick action."

In *Societe Anonyme, &c., vs. Rehfus*, 75 F. R., p. 657, Judge ACHESON said :

"That the patent office imposed, and the applicant accepted, the limitation upon which the defendants insist, would be a strained conclusion. *An estoppel is not to be implied from circumstances of doubtful import.* This is a fundamental invention, and, upon well-considered principles, the patentee and his assignees would have the benefit of the doctrine of equivalents in large measure. Looking at the entire proceedings upon Cleret's application, it cannot, I think, fairly be said that either the patent office, on the one side, or the applicant, on the other side, contemplated a limitation which would render the claims practically valueless, and make the grant of the patent a vain thing. Let a decree in favor of the plaintiff in each case be drawn."

In *McCormick vs. Aultman*, 69 F. R., p. 371, the Circuit Court of Appeals (Judge TAFT, delivering the opinion) said (p. 393) of the facts which should limit a pioneer patent, as follows :

"*Nothing* will restrict the pioneer patentee's rights in this regard save the use of language in his specifications and claims which permits *no other reasonable construction* than one attributing to the patentee a positive intention to limit the scope of his invention in some particular to the exact form of the device he shows, and a consequent willingness to abandon to the public any other form should it be adopted and prove useful."

Only one other change in the original application was made. Mr. Westinghouse in his original specifications stated the *fact* that

the valve, which, on being opened, gave *emergency* action, instead of being made *separate* from the main valve of the triple, might be made "integral" herewith, and be "formed by an extension thereof." This is so obviously a mechanical equivalent that the statement of the fact would seem to have been useless and superfluous. But as he did not illustrate this particular modification in his drawing, the Patent Office told him that he must either illustrate it or erase this brief reference to it—such being the Patent Office rule at that time (Hogan, Rec., p. 277). He erased it. This is the whole story. But by no rule of law ever yet enunciated can it be held that the erasure of a description of a mechanical equivalent operates as a disclaimer of such mechanical equivalent. The patentee is always entitled to the full benefit of the doctrine of mechanical equivalents, so far as it may apply, whether he describes them or not. The law gives them to him anyhow.

Winans vs. Demead, 15 How., 330, 342.

Goodyear Co. vs. Davis, 102 U. S., 222, 230.

Clough vs. Barker, 106 U. S., 166, 177, 178.

[See cases cited in our original brief, p. 98, and those above quoted.]

But again, this erasure, no matter whether it had the effect of a disclaimer or not, is irrelevant to the present case, for the reason that the defendants' *emergency* valve 22 is *not* made "integral" with the *service* or "main" valve *i, j, k* of its triple valve. Hence, in any view of the case, defendants' apparatus comes within the metes and bounds of the grant made to Westinghouse in and by the patent in suit.

As to the Patent Office action in granting patents to Boyden, *pending the suit*, such action amounts merely to a Patent Office decision that Boyden had made some patentable improvements on Westinghouse, but the Patent Office has under Act of Congress no jurisdiction of the question as to whether these additional improvements *actually contained* the prior Westinghouse invention. That question, under Act of Congress, belongs to the courts. In fact, the

Patent Office has never even presumed to adjudicate questions of that kind, and even if it had, its action would be *ultra vires* and void.

What is said in the Boyden specifications on this point are nothing more than the voluntary *ex parte* statements of Boyden or his counsel, put in writing and printed at the expense of the United States. The Patent Office had no authority under the law to determine whether such statements were true or not, and therefore no presumption arises from the issue of the Boyden Patents as to whether they are true or not.

[For the law here applicable see cases cited in original brief, pp. 98-100.]

Fourth Point. The final point suggested by the Court now presents itself.

We have shown that nothing in the prior art, nor in the proceedings in the Patent Office, tend to limit the scope of the Westinghouse invention, and the claims which purport to cover it, so as to make inapplicable to them the beneficial rule announced by this Court—that, in the case of pioneer patents, rules of construction are to be adopted analogous to those which prevail in the case of process patents.

We now inquire, are the terms of the Westinghouse claims themselves of a character to admit of the application of this rule?

We respectfully submit that they are.

Westinghouse's first claim calls for the combination with the train-pipe, auxiliary reservoir, brake cylinder, and a triple valve of any of the forms of the old automatic brake apparatus (*Westinghouse says in the patent in suit (Rec., p. 788, line 18) that there were "numerous examples in the art of constructions varying materially in appearance"*), of an "auxiliary valve device" actuated by the piston of the triple valve, and independent of the main valve, for admitting air to apply the brakes, directly from the train pipe to the brake cylinder.

The second claim (specifying the invention, as it correctly may, from another point of view) particularly points out as the invention of the patentee the use (in combination with *any* of the numerous forms of automatic triple-valve brake mechanism) of the "preliminary traverse" of a triple-valve piston to admit air from the auxiliary reservoir to the brake cylinder, and of the "further traverse" of the triple-valve piston *to admit air from the train pipe to the brake cylinder*.

Whether the described intermediate connecting parts are or are not the same is of course immaterial (*Winona Co. vs. Deering*, 155 U. S., 285).

The first claim differs from the second in that it does not *require* a piston with a *double* traverse to be used (the specification suggests a "series of pistons" (Rec., p. 788, l. 17) instead of one), but defines the invention as residing in the use of a valve ["auxiliary" to the main (or "service") valve] for opening the port from the *train pipe* to the brake cylinder.

The second claim defines the invention by another of its important characteristics, to wit, that the triple valve piston is one which has a *double traverse*, and that the preliminary traverse is operative to control the admission of air from the auxiliary reservoir to the brake cylinder, and the further traverse is operative to control the admission of air from the train pipe to the brake cylinder.

The second claim, although literally a claim for a mechanical combination, is yet so phrased as to clearly entitle it to the liberality of scope accorded in analogy to the rule applied to process patents.

In a process patent the claim describes a certain action as taking place and producing a stated result, and the claim is valid to that extent and "irrespective of the particular form of the instrumentalities used" by which the action is effected and the result is produced (*Cochrane vs. Decner*, 95 U. S., 780).

In Westinghouse's second claim the gist of the invention is stated in the sentence which describes the triple-valve piston as acting by its preliminary traverse to open a passage from auxiliary reservoir to brake cylinder, and by its further traverse to open a

passage from train-pipe to brake cylinder. Now, such actions can only take place *by the opening of ports and passages* from the respective sources of air pressure to the brake cylinder, and hence (as pointed out in our supplemental brief, p. 27) such claim is equivalent to the following, viz.:

2. In a brake mechanism the combination of a main air pipe (train pipe), an auxiliary reservoir, a brake-cylinder and a triple valve having a piston whose preliminary traverse (*by opening a port*) admits air from the auxiliary reservoir to the brake-cylinder, and which, by a further traverse (*by opening a port*), admits air directly from the main air pipe (train pipe) to the brake-cylinder, substantially as set forth.

But under *such* a claim, relating to *such* an invention, the *particular valves* and the *particular passageways* are "not necessary constituents of the claim" (*Lancaster Co. vs. Morley, supra*) any more than the particular mechanism for effecting a specified step of a new process is essential to the infringement of that process.

The Telephone Case, 126 U. S., 1.

New Process Co. vs. Maus, 122 U. S., 413.

We submit, then, that the phraseology of the claims themselves, and particularly of the second claim, is such as to entitle the complainant to invoke the rule and breadth of construction analogous to that prevailing in the case of process patents; and this is also true, although the claim be construed strictly as a mechanical combination.

In *McCormick Harvesting Machine Co. vs. Aultman*, 69 F. R., 371, the Circuit Court of Appeals for the Sixth Circuit said (p. 387) (following the Court in *Lancaster vs. Morley*):

"With respect to such a patent, the well-established rule is that the patentee who has, by the success of his patent, pointed out the combination of functions needed to reach the new result, and has claimed the combination of mechanical parts performing those functions, may enjoin the use of another machine producing the same result where the second machine differs from the first only in a substitution, for parts or elements of the patented device, of parts or elements which, though different in form and kind, perform the same functions in substantially the same way. It may be that the substituted parts are well-known equivalents of those shown in the patent for the performance of the functions to which they are respectively applied, in which case there is manifestly no inventive

faculty shown in the change, or it may be that, being shown by the successful operation of the patent the exact nature of the functions to be performed by a part of the patented device, the infringer, by the use of his inventive faculty, hits upon something as a substitute which will perform the same functions more completely and satisfactorily. In the latter case, he is a tributary inventor, but he is none the less an infringer if he uses the whole machine, with his substituted part to accomplish the same new result. The rule as to infringements of pioneer inventions which point the way to new products or results is analogous to that applied in cases of infringements of process patents, in which the discoverer is only required to point out one practical method of using his process, and is permitted to claim tribute from all who thereafter use the process, whether with his apparatus or with a different or improved means."

Westinghouse's first and second claims, because the general purpose and function of the structure as a whole was new, are entitled to such a construction, that if the defendants' general purpose be the same as his, and the separate purposes and operations of the separate parts of their combination be also the same, then infringement is established.

This is the rule laid down by this Court in *Cochrane vs. Deener*, 94 U. S., 780, in connection with Cochrane's Patents, not only for his process, but also for his *apparatus*, for purifying middlings of flour (Reissue No. 6594).

That case has some features of marked similarity to the present one in the fact that the apparatus was one whose method of operation "underlay" a revolution in the art of making purified flour "middlings," and in the fact that the form of apparatus described by the patentee had been greatly improved upon (and in *that* case by the defendants themselves, while in this case by Westinghouse himself); and in the fact that the generic claim for the apparatus first advanced by the patentee (and in *that* case granted) had been subsequently amended and restricted to the actual invention (in *that* case by reissue).

Yet, notwithstanding all this, this Court said :

"The first claim of Reissue No. 6594 is for the collecting air chamber (used for the purpose aforesaid), in combination with the bolter, air pipes and valves for feeding and delivering the meal without allowing the air to pass therewith. Now, although the

defendants use a flat bolter instead of a reel, and use different kind of valves for feeding and delivering the meal without allowing the air to pass, yet they employ the combination of devices described in this claim. They use the collecting chamber *for the same purpose* as that pointed out in the patent, and use it in connection with bolter, air pipes and valves for feeding and delivering the meal without allowing the air to pass therewith, *each effecting the same separate purpose, and all combined effecting the same general purpose*, which the like parts are intended to accomplish in Cochrane's bolting apparatus. Though some of the corresponding parts of the machinery designated in this combination are not the same in point of form in the two bolting apparatuses, and, *separately considered, could not be regarded as identical or conflicting*, yet, having the same purpose in the combination, and effecting that purpose in substantially the same manner, they are the equivalents of each other in that regard. The claim of the patent is *not confined to any particular form of apparatus*, but (in regard to the valves, for example) embraces generally any valves for feeding and delivering the meal without allowing the air to pass through. We are of opinion, therefore, that the combination here claimed is infringed by the apparatus used by the defendants.

"It is unnecessary to make a separate examination of the other claims embraced in the two patents under consideration. They are all susceptible of the same observations which we have made with regard to the first claim. In our opinion, the defendants do infringe them."

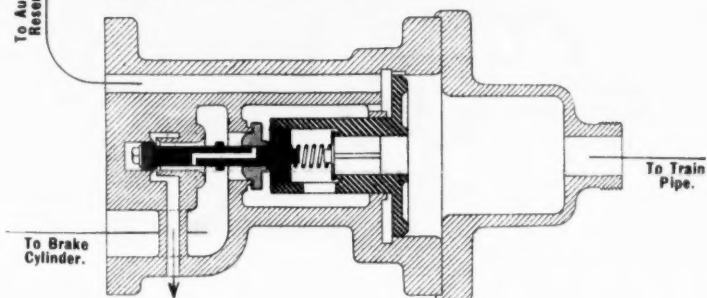
Such is the case here.

The defendants manufacture and sell a brake mechanism (shown in its three positions in Drawing 14 opposite), which combines a train pipe, auxiliary reservoir, brake cylinder and a triple valve. The piston of this triple valve controls two valves (and their ports) for admitting air to the brake cylinder, one (the slide valve, with its port *i j k*) for admitting air from the auxiliary reservoir for most (if not *all*) "service" uses, and the other (valve 22), or "auxiliary" valve for admitting train-pipe air for emergency use. The purpose and object of their structure is admittedly identical with that of Westinghouse's patent. Also the separate purposes and functions and operations of the corresponding parts of defendants' device are the same as those of Westinghouse.

The preliminary traverse of the defendants' piston controls and opens the first-mentioned or "service" valve (slide valve *i j k*), and the "further traverse" of the piston controls and opens the second or "emergency" valve (valve 22).

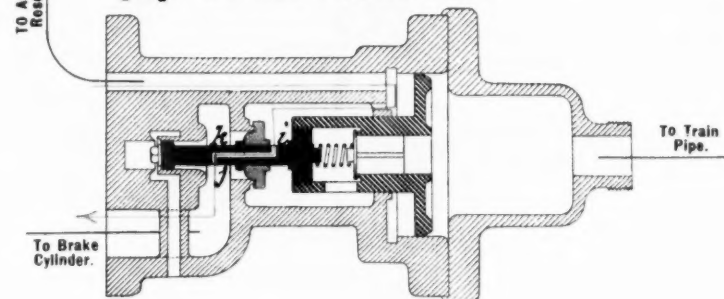
To Auxiliary
Reservoir.

14—Release (Brakes Off).



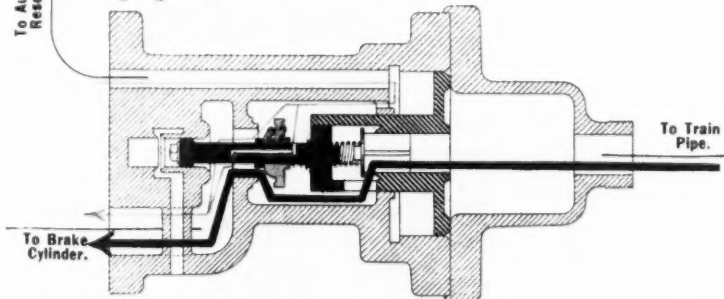
To Auxiliary
Reservoir.

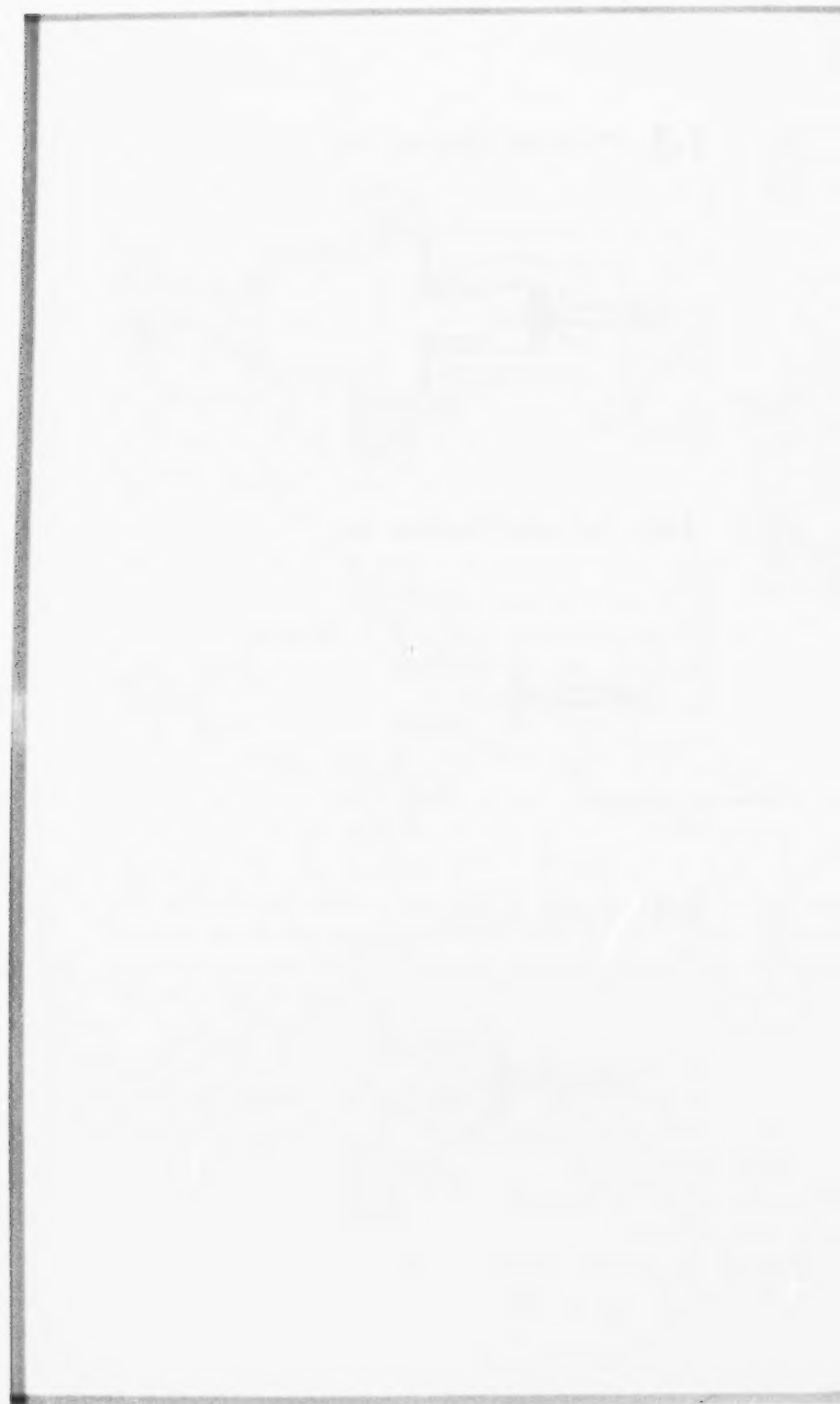
14—Service Application.



To Auxiliary
Reservoir.

14—Quick Action.

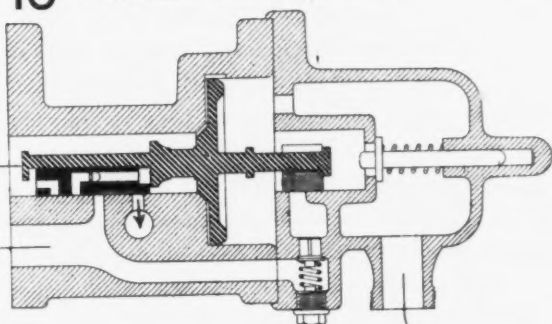




10—Release (Brakes Off).

To Auxiliary
Reservoir.

To Brake
Cylinder.

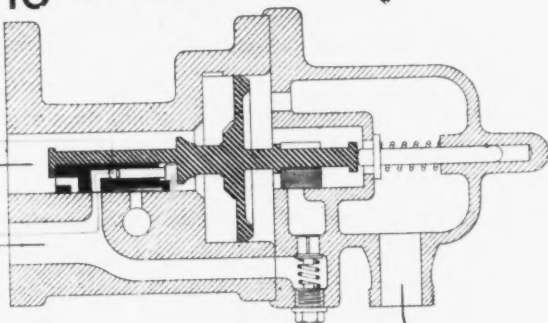


To Train Pipe.

10—Service Application.

To Auxiliary
Reservoir.

To Brake
Cylinder.

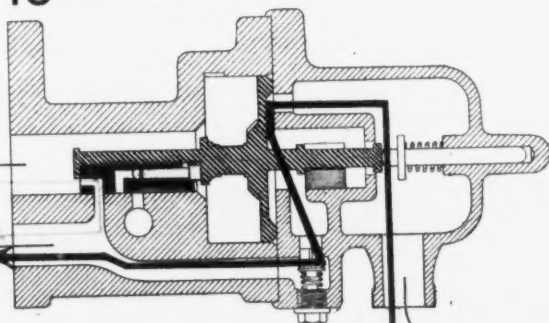


To Train Pipe.

10—Quick Action.

To Auxiliary
Reservoir.

To Brake
Cylinder.



To Train Pipe.

This is the identical action of Westinghouse.

Thus we have a clear case of infringement within the rule laid down in *Cochrane vs. Deener*, in that the "general purpose" of the whole combination of devices is the same as that of the patentee's, and the "separate purpose" of the separate parts is the same as the like parts of the patentee's device, and the purpose in each is effected "in substantially the same manner;" and this constitutes infringement in the case of a pioneer patent, although some of the corresponding parts of the machinery "are not the same in point of form," and, "separately considered, would not be regarded as identical or conflicting."

We have shown, in our prior briefs (Principal Brief, pp. 60-69; Supplemental Brief, pp. 6-14), by a careful analysis of the separate features of the defendants' valves, that even upon a narrower construction of Westinghouse's claims, the defendants' devices are clearly equivalents to his.

They have built (as we have there shown) upon one old form of Westinghouse triple valve (Patent No. 141,685) instead of upon his other form of triple valve (Patent No. 220,556) and have reversed the position of some parts, and altered the form of others. Defendants' piston, by its further traverse, *pulls* the emergency valve (valve 22) off its seat, while Westinghouse *pushes* a valve off, by a like motion. But, under clever disguises, all of Westinghouse's parts are to be seen, and every function and mode of operation is accomplished.

This will be clearly apparent from a careful comparison of the Drawing 14 of defendants' valve with drawing of Westinghouse 10 on the opposite page (see analysis in Principal Brief, pp. 64, 65).

No matter, then, how the separate parts may differ in form from those of Westinghouse, and no matter whether the valves, as valves, may be "poppet" valves instead of "slide" valves, or *vice versa*; and no matter whether the passage for train-pipe air be *through* the piston and case of the triple-valve, instead of *at the side of it*. The general purpose of the mechanism, as a whole, is the same, and is effected in substantially the same manner, and the separate

purpose of each separate part with reference to the others is also the same (even although they may have some additional functions also); and infringement of such a patent as that of Westinghouse is, therefore, clearly demonstrated.

As was said by the Circuit Court of Appeals (9th Circuit) in *Von Schindt vs. Bowers* (80 F. R., 121, 148):

"The record shows that the complainant was the first to combine these elements at all, and that the functions performed by his machine so constructed were entirely new. Hence, he had the right to make the broad and generic claim [embodied in Claim 10] without any limitation as to the form of construction of the particular elements, and all subsequent machines which employ substantially the same means to accomplish the same result are infringements, notwithstanding the subsequent machine may contain improvements in separate mechanism which go to make up the machine."

In the foregoing discussion we have endeavored to follow the lines indicated in the memorandum of this Court of January 24, but we also submit that, even upon much more rigid principles of construction of the patent in suit, infringement is clearly established.

In our former briefs we have dealt, we believe, with each and all of the positions advanced by the defendants, and we hope that we have successfully controverted them; and we have shown, by a series of illustrative drawings, that each and every change of position or shape of parts which has been adopted by the defendants is a mere equivalent, and a known equivalent, for the corresponding part of the Westinghouse device.

In our view "the purpose, principle and operation of the machines are the same" (*Consolidated Cable Co. vs. Pacific Cable Co.*, 53 F. R., p. 385), and the patent in suit is entitled, by virtue of the revolution which it has wrought, and the benefits which it has conferred, to such a "comprehensive construction" (*Norton vs. Wheaton*, 57 F. R., 927) as will fully and adequately protect the inventor and his assignees.

Respectfully submitted,

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Counsel for Respondents.

Errors in Appellee's Brief on Second Argument.

Outside of errors of argument, the Boyden brief, on reargument, contains numerous errors of incidental statement or recital, a few of which may be briefly noted.

1st. Page 8, line 4, from bottom, denial is made that in defendants' triple valve, *train-pipe* air goes to the brake cylinder "through any separate and independent passageway."

This is erroneous. Defendants' quick-action triple valve has a "separate and independent passageway," F, *through the triple valve piston*, which is opened when and only when *train-pipe* air is to be admitted to the brake cylinder for purposes of quick action (see lower drawing, facing p. 40 of first Westinghouse brief).

2d. Page 10, lines 2-7, do not correctly state the Commissioner's duty in the case in hand. When Boyden's later application was properly filed, all the Commissioner had to do was to determine whether the *particular combinations* of the claims so submitted were to be found in the prior art. Whether those *particular combinations* were based on or included the subject matter of inventions previously patented to somebody else is a question which belongs to the Courts and not to the Commissioner, under Act of Congress. The Commissioner could not pass on that question, and if he did his action would be nugatory, as *ultra vires*.

3d. Page 18: It is represented that the apparatus of the patent in suit, "although it is an operative device," "did not meet the public demand," etc.

This is erroneous. It *did* meet the public demand, although, like all primary forms of invention, it was subsequently improved upon. Two thousand of them were made and sold and went into public use.

Westinghouse Rec., pp. 305, 306, x-Qs. 485, 486.

This charge has been repeatedly disposed of in every litigation, and the proofs on this subject and the decisions of the Courts thereon are fully dealt with in our principal brief (pp. 33-38). A

similar contention was advanced in the Circuit Court of Appeals for the Ninth Circuit in *Von Schmilt vs. Bowers*, 80 F. R., pp. 121-150.

In that case the Court said:

"The contention on the part of counsel for the appellant that no successful machine can be built and operated in accordance with the complainant's patents is not at all supported by the record, which contains abundant evidence to the effect that machines have been so built and have ever since been operated with very great success. The fact, if fact it be, that the first machine built by the complainant (called in the record the 'Davis machine') was not successful in its operation, is unimportant. As was well said by the Court, in answer to a similar objection in the case of *Mergenthaler Linotype Co. vs. Press Publishing Co.*, 57 F. R., 506:

"It would certainly be a novel doctrine to deny to an inventor the fruits of a broad invention because the machine which first embodied it was rudimentary in character and failed to do as good work as improved machines made subsequently. None of the great inventions could survive such a test."

To the same effect see *Cochrane vs. Deener*, 94 U. S., 780, 786-7.

4th. Page 21, line 5, by the words "*not because of any change in them*"—that is, in the old automatic triples—implies the assertion that Boyden in his present construction has adopted an old automatic triple *without any change therein*.

A valve 22, loose on its stem, so that it will *stay* on its seat during the *preliminary* movement of the triple-valve piston, as in service use, and will be unseated by the *further traverse* of the same piston, to admit air from a different source of pressure, as in quick-action use, is not found in any of the old automatic valves referred to. Making the stem itself into one valve, for one purpose, and a loose valve on the stem, for the other purpose, and operating it by the "further traverse" of the piston, was a "change" in matter of substance.

5th. The same error appears in the same page, lines 5 and 4 from the bottom, "without any material change therein."

6th. The entire argument of page 22 is misleading. Defendants' quick-action triple valve contains "*two [mechanically] separate and*

distinct machines" (just as much as Westinghouse's). The one consists of the triple piston, *in re* its preliminary traverse, opening the main-stem valve *i j k*, for "service" use; and the other consists of the piston, *in re* its further traverse, opening a separate and independent passageway F through the piston, and unseating an "additional" or an "auxiliary" valve 22, for venting train-pipe air directly to the brake cylinder in "quick action." The valve 22 and the passageway F are "additional members," and, in effect, constitute "another machine" as much as do the corresponding parts of Westinghouse.

7th. On page 24 an erroneous meaning is attributed to the word "*directly*." As this word is used by Westinghouse, it draws a distinction between the air which is *previously stored* in the auxiliary reservoir, and there held for use, and the air which is *not* so stored and held, but travels at once, or "*directly*," from train pipe to brake cylinder. Observing this distinction the word "*directly*" applies equally to the Westinghouse patented apparatus and to the Boyden infringing apparatus.

8th. "Reasoning by exclusion" (p. 25) is a method of reasoning which the Courts have never yet adopted in dealing with novel meritorious inventions.

9th. Lower on the same page (25) the allusion to "*mechanism integral therewith*" involves *apparently* an effort to get this Court to pass on an issue which does not arise in this case. Defendants' valve 22 is not "integral" with valve *i, j, k*. It is a different, and an "auxiliary" valve."

10th. The assumption that an erasure is always a disclaimer (p. 26) is not well founded in law. We have discussed this elsewhere.

11th. The "integral" issue, which, as already stated, is not involved in this case, is again made the basis of an effort at argument on page 27.

12th. We have never contended, and do not now contend, that "*remaining claims or any substituted claim*" shall receive "a construction or interpretation which shall be tantamount in scope and comprehensiveness to the original and erased statement and first claim" (B. brief, p. 28).

The original and erased first claim *in terms* covered the valve of the 1883 Boyden Patent. The present claims do not. And right there lies the distinction in respect of the proper legal construction of the claims as they now stand.

13th. The Circuit Judge did not assume that "such 'further' traverse was *per se* new" (p. 31). He found what was true, that it was new *in re* its work of *admitting train pipe air* to the brake cylinder.

14th. The "integral" issue is again worked in as the basis of the argument (p. 34).

15th. Assertion is again made (p. 35) that "defendants' device has no additional passageway at all," and no "auxiliary or other valve," etc.

We have already pointed out the passageway F through the triple piston is an "additional passageway," and that 22 is an "auxiliary" valve.

This error, repeated over and over again, runs through the entire Boyden brief, and it would unduly lengthen these notes to point it out wherever it occurs.

16th. It may be noted that the alleged analogies between *Gill vs. Wells* (pp. 43-54) and the case at bar are wholly suppositions. Infringement was denied in *Gill vs. Wells*, because (1st) the patent was not of a pioneer nature; (2d) the defendant "entirely omitted" an express element (guiding devices) of the patentee's claim *and used no equivalent*. Analogies are of but little force at best, and when *wholly imaginary* it is difficult to see how they can have any force at all.

17th. What is said of the lower drawings facing pages 64, 65, and entitled, "The Old Poppet Form of Triple Valve," *seems* to assert that a valve 22, *loosely* mounted on the stem (also made into a valve) of a triple-valve piston was old in the air brake art. *This is not true, nor is there any evidence in the case showing or tending to show that it is true.* Hence, the argument based thereon, and running through several following pages, is fallacious.

A poppet valve *fixedly secured* to the piston stem, so that the valve would open or close with *every* movement of the piston, was old, and constituted the main valve. When defendants made that valve *loose* on its stem, and so that it would be opened only by the "further traverse" of the piston, and made it "auxiliary" to the main valve *i, j, k* (or 40), it became an "auxiliary" quick-action valve, "additional" to the main valve, and, as such, it became mechanically and operatively "an additional member," operated by the "further traverse" of the piston, so as to open an additional passage F, directly from the train pipe to the brake cylinder—the passageway F thus being the other "additional member."

18th. The facts as to the presence in Westinghouse of what is in substance the partition 9, is presented in both of our prior briefs (Original, pp. 100-106 ; Supplemental, p. 12). Boyden is not the inventor of a *choke* for auxiliary reservoir pressure. That is in every quick-action valve ever made.

19th. The assertion (p. 79) that the Boyden piston "performs *only one* function" is not well founded. It performs *one* function during its preliminary traverse in that it opens the main valve *i, j, k* (40), the valve 22 then remaining on its seat. It performs *another* function when, in its "further traverse," it unseats the valve 22, which latter thereby acts as an "auxiliary" valve. The passageway F then opens, and the "new function" of the Westinghouse Patent is then performed.

20th. The effort (pp. 84, 85) to ally defendants' present appa-

ratus with that of the Boyden 1883 Patent ignores an important difference.

The passageway F in the present valve of defendants is not "*always open one way*." In "*service*" use it is *always closed*. Westinghouse disclaimed the former, but not the latter. Defendants' present valve contains the latter and not the former. The Boyden brief carefully ignores this important difference.

21st. "Differential pressures" between piston chamber and main valve chamber (pp. 85, 86) are of no importance. Both are small. The forces which *do the work* are *auxiliary reservoir* air and *train pipe* air. As between *these forces*, Westinghouse has the same differential pressures which Boyden has, and for the same purposes, and secured in the same way—by admitting *auxiliary reservoir* pressure through a *small* port, and *train-pipe* pressure through a *large* port. The Boyden brief admits as much when it says (p. 85, near bottom): "Of course, all triple valves in operating must have differential pressure."

N^o. 116 (and 99)

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OCTOBER TERM, 1897.

Filed Mar. 11, 1898.

No. 116.

GEORGE WESTINGHOUSE, JR., ET AL., APPELLANTS,

vs.

BOYDEN POWER BRAKE COMPANY ET AL.,
RESPONDENTS.

**Memorandum in Reply to New Boyden Brief on
Third Argument.**

There are two points made in the new brief on behalf of the Boyden Company which are so different from any position heretofore advanced, and, as we trust to show, so erroneous, that we may be pardoned, we think, for requesting permission to file this brief reply.

These two positions are as follows:

First. That no brake is to be classed as a "quick-action" brake which has not the capacity of producing "full application of the last brake on a train of 50 cars within $3\frac{1}{2}$ seconds from the operation of the engineer's controlling cock." This position is advanced on page 5 of the Boyden

brief, and is attempted to be supported by a citation in a note at the foot of that page from the proceedings of the Master Car Builders' Association of 1895 nothing of which appears in the record.

This proposition is repeated all through the argument, and, basing the definition of a "quick-action" brake upon this asserted formula, enunciated in 1895, seven years after the issue of the patent in suit, the brief proceeds to argue that the "quick-action" brake of the patent in suit, No. 360,070, is really not a "quick-action" brake at all, because, upon its first trial, in Burlington, in 1886, it only attained (owing to mechanical imperfections and disproportions) a serial rapidity of six seconds on a 50-car train.

We cannot assent to the correctness of a position which asserts that a standard of efficiency, formulated years after the date of the invention, and based upon its most improved and carefully made forms, is to be taken as a controlling factor in determining the position and value of the mechanism of the patent in suit.

This suit must be determined upon the *record* herein; and the value and position of Mr. Westinghouse's invention must be determined as of the date when it was made.

We have already shown that Westinghouse's invention has features of utility of controlling importance quite different from and independent of any *particular* rate of rapidity in serial action; and this fact will, we think, become still more evident in connection with our answer to the second erroneous position in the Boyden Company's brief.

Second. The second of the two positions in the Boyden Company's brief, which is both novel and erroneous, is this:

On pages 13 to 21 the brief proceeds to point out that between the time when the old automatic brakes used at the Burlington trials of 1886 failed to do satisfactory work, and

the time when Mr. Westinghouse made the invention in suit, which was patented in No. 360,070, March 29, 1887, certain intermediate valves were made, which are described in the testimony of Mr. H. H. Westinghouse, on pages 123 and 124 of the Record, and one of which purports to be illustrated opposite page 16 of the new Boyden Brief. These intermediate valves, it is contended, are to be considered as part of the state of the art prior to the patent in suit, and it is claimed that they tend to limit its scope and impair its position as a pioneer.

In connection with this part of the argument, we desire to call attention to the following facts:

1st. That, on page 16, the brief asserts that "The 'cut' opposite this page illustrates the arrangement described by Mr. Westinghouse."

We can only say that this "cut" is wholly imaginary. No such "cut" is found in the Record, and no structure is described of which the cut can be *fairly* treated as a proper illustration.

The "cut" is *not* the thing which Mr. Westinghouse describes. It adds, among other things, a piston K *to close the discharge port at the proper time*, which Mr. Westinghouse does *not* say was provided, and the presence of which is in conflict with the express statement of Mr. Westinghouse that the use of this experimental discharge resulted in "*a complete exhaustion of the train pipe.*" The significance of this gratuitous addition of piston K will appear later.

2d. The brief asserts on the same page (16) that the arrangement of the intermediate form of valve which operated to discharge air from the train pipe to the atmosphere "does not appear by any evidence in the case to have been the invention of Mr. George Westinghouse, Jr." As to this

last remark, we submit that the record shows exactly the contrary.

Mr. H. H. Westinghouse, in prefacing his description of the supplemental tests which were made, and which led up to the making of the invention of the patent in suit as a result of the failure of the automatic valves at Burlington in 1886, said (p. 122):

"An examination of the results obtained led George Westinghouse, Jr., to make investigations with a view to so changing the form of brake apparatus as to have the effect of operating with a *less interval of time* between the apparatus of the several cars, and also, if possible, provide for a *greater available force*, so as to arrest the motion of the train in a less distance than had been done in the 1886 Burlington trials."

He then proceeds to describe the two preliminary experiments relied upon by the Boyden counsel, viz., 1st (p. 123), the placing in the train pipe at regular intervals of "a form of delicately adjusted exhaust valve," which he says caused a nearly uniform application of all the brakes in "service" applications, but which were of such an "extremely delicate nature" as to render their practical use "extremely doubtful," and which merely "served to demonstrate *the direction of further experiment*;" and, 2d (p. 124), *some apparatus* arranged with an auxiliary valve controlling communication between the brake pipe and the atmosphere and operated by the final travel of a triple-valve piston, which while also quickening serial application resulted in "*a complete exhaustion* of the air from the train pipe at each triple valve."

Mr. H. H. Westinghouse then adds that these suggestive but imperfect experiments finally culminated in the device of the patent in suit, which embraced a *combination*, in one unitary structure, of mechanism for securing *for emergencies*

only, a greatly augmented brake force ("fully 20 per cent.") and a *controlled* quicker serial application of brakes. By *controlled* "quick action" we mean such action as can be caused to operate or remain inoperative at the will of the engineer, and can be applied and re-applied at will, without sacrificing the other necessary functions of a "service" use and graduating use and prompt release after application.

Mr. H. H. Westinghouse concludes his narration of the history of the experiments which led up to and culminated in the invention of the patent in suit by saying of them all (p. 125).

"The experiments and improvements and changes above described were carried on by the suggestion and under the direction of George Westinghouse, Jr."

It is difficult, therefore, for us to understand how the Boyden brief can assert so positively that the record does not show that the alleged intermediate forms were the work of Mr. George Westinghouse, Jr.

But whether they were or were not the work of Mr. George Westinghouse, Jr., is of no real importance, for they resulted, at the time, in nothing practical, and, as mere tentative experiments, they cannot be used to detract from the novelty or merit of Mr. Westinghouse's great invention embodied in the patent in suit. Nor can that invention be minimized by the erroneous assertion that nothing is a "quick-action" brake which does not apply the last brake on a 50-car train in three and one-half seconds.

Mr. Westinghouse's pioneership stands upon a foundation quite different from any mere *rate* of serial quickness of application.

Quickened serial application had been proposed by him in

his patent No. 217,838 seven years before. But *mere* capacity for quickened serial application is not enough. If it had been, it would have been practically utilized long before 1887. The long and heavy freight trains of the modern art, and which modern railway practice had rendered essential, required a brake of *augmented force held under control* for *emergency use* and also one possessing *controlled* quicker serial application.

Greater efficiency of the brake in the rare instances of emergency application, when life and property were in imminent peril, could not, however, be provided for at the sacrifice of the every-day capacity of the brake for "service" use. A brake which is more powerful and quicker in serial application would be a *useless* thing if those qualities were attained only at the sacrifice of the capacity for either delicate graduation or full "service" application at will, or of the power to instantly release the brake after it had been once applied.

A "quick action," which was *always* "quick action," would be an utterly useless brake; a more powerful brake, which must *always* be more powerful, would be an impractical thing.

Hence, neither the suggestion of patent No. 217,838, nor the tentative experiments made by Westinghouse, in his shop, in 1886, in his endeavor to devise *the successful* freight brake of the future, have any relation to the present invention, except to indicate how complicated and difficult the problem was which was solved by it.

A brake of augmented force in emergencies, and in emergencies *only*, and of quickened serial application, but which was not "quick action" *always*, but was under control, was the *desideratum*. A "quick action" which was not destructive of the most important functions of the brake for

ordinary "service" use and which did not depend upon mechanism too delicate to be practical, and which was so organized as not to prevent the brake being released after it had been once applied, was the thing which was required.

All these features are embodied in the invention and apparatus of the patent in suit. None of them are found in the prior patent, No. 217,838, nor practically embodied in the tentative experiments of Westinghouse himself which led up to the patent in suit.

An auxiliary discharge valve of such an "extremely delicate nature," as to make its practical use "extremely doubtful," did not solve the problem, nor did it add anything to the art.

The mere discharge of train-pipe air by a valve controlled by the triple-valve piston, but which, when once opened, resulted in "a complete exhaustion of the air from the train pipe at each triple valve," would be likely to be a valve which could not be released until the brake apparatus of the whole train was manipulated by the few train hands. Hence it added nothing to the art.

The "cut" opposite page 816 of the Boyden brief, and which purports to illustrate the experiment which Mr. H. H. Westinghouse described, *supplements* that description, by illustration of a complicated piston-operated aperture-closing valve (marked "K"), no suggestion of which is made in the record, nor is any description found of how it could be utilized to stop the discharge of air.

By discharging the vented air from the train pipe into the brake cylinder, as the result of the final movement of the piston of a triple valve, Westinghouse solved the complicated problem of "quick action," placed it under immediate control by the engineer, and accompanied it by aug-

mented train-stopping force combined with an *unimpaired* capacity of the apparatus for every function of ordinary use.

Until *all* these things were done, "quick action" was, for practical railroad purposes, unaccomplished.

George Westinghouse, Jr., did them all. He was absolutely the first to accomplish each one of three fundamental features of practical "quick action," viz:

1. Augmented power in emergencies, and in emergencies *only*.
2. *Controlled* quickened serial action, which could be had, or *not* had, at will.
3. "Quick action" with unimpaired capacity for all the necessities of "service" action.

The fact that, in his first apparatus, *one*, and *one only*, of his novel features—that of *controlled* quick serial action—was not *as rapid* as he himself afterwards made it, is a matter of no controlling importance.

GEORGE H. CHRISTY,
FREDERIC H. BETTS,
Of Counsel.



Supreme Court of the United States.

BOYDEN POWER BRAKE COMPANY

ET AL.,

Appellants,

VS.

GEORGE WESTINGHOUSE, JR., ET AL.,

Appellees.

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BOYDEN POWER BRAKE COMPANY

ET AL.,

Appellees.

Petition for Rehearing.

Your petitioners George Westinghouse, Jr., and the Westinghouse Air Brake Company, complainants and appellees, hereby respectfully represent to this Court as follows:

FIRST. That, as they are advised and believe, this Court has been led into error in its opinion filed May 9th, 1898, in finding that the "auxiliary valve" of Boyden (valve 22) is *located and arranged* in combination with the other parts of the triple-valve structure, in a substantially different manner from that of the auxiliary valve of the Westinghouse Patent in suit (valve 41), and so as to be productive of different results from those produced by the Westinghouse auxiliary

valve; and in finding that a passage for train-pipe air (admitted by said valve) *through* the valve chamber, is substantially different from a by-passage for train-pipe air *around* said valve chamber.

Whereas, as your petitioners believe, this difference in location of the auxiliary valves, and passages opened thereby, is *not* material, and has been so proved in the record, and is in substance so admitted on the part of the defendants in one of the Boyden Patents No. 481,136 (Record, pp. 817, 823).

SECOND. That, as they are advised and believe, this Court has been led into error in its finding that there is "*no partition in the proper sense of the word,*" in the valve structure of the Westinghouse Patent in suit, "*or, at least, none located as in the Boyden device,*" and "*no aperture in such partition open for the express purpose of maintaining differential pressures on opposite sides of a check-valve which opens in emergencies to admit train-pipe air to the brake cylinder.*"

Whereas, as a matter of fact, there has always existed in the said Westinghouse "quick-action" structure, and is described in the Westinghouse Patent in suit a restricted port 35, in an extension of the main valve, which constitutes a partition substantially of the character of that in the Boyden structure, and is located in substantially the same relation to the other parts of the structure, and said restricted aperture necessarily operates to produce "differential pressures" on opposite sides of the Westinghouse check-valve, and is productive of substantially the same results as those produced by the said restricted aperture in the Boyden structure, and this is substantially admitted in the record, and is clearly to be inferred from the said Boyden Patent No. 481,136 (Rec., pp. 823-4).

THIRD. That this Court has been led into error in supposing that the device of the defendants' is substantially different from that of Westinghouse, and "*is a novel one and a manifest departure from the Westinghouse Patent,*" because, as was supposed by the Court, Boyden "*made a more perfect brake than the one described in the Westinghouse Patent.*"

Whereas, there is no proof in the record that the defendants' device is, in any way, or to any degree, better, simpler or

more efficient in producing "quick action" or quickened "serial action" or "quick action without shocks," at the rear end of a long train, than the exact form of apparatus described and illustrated in the patent in suit, but, on the contrary, the proof is that the said Boyden valve is, if anything, inferior to that of the patent in suit.

In support of the first paragraph or section of this petition your petitioners respectfully represent as follows :

The location of the Boyden auxiliary valve 22 upon one side—viz., on the auxiliary reservoir side—of the triple valve piston (and hence *in* the valve chamber), instead of upon the other, or the train pipe side, of the triple valve piston (and hence *outside* of the valve chamber), and the consequent difference of flow of train-pipe air admitted by said valve *through* the valve chamber (as described by Boyden), instead of *around* the valve chamber (as described by Westinghouse) is admitted in the patent of Mr. Boyden himself to be a difference which does not affect either *essential* features of the structure, or the mode of operation or the result.

The Boyden Patent No. 481,136 (August 16, 1892, Record, pp. 817-828) describes a form of quick-action valve operating by the same "momentary differential pressures" (see Rec., p. 821, 5th line from foot of page) as the form involved in this suit, but differs therefrom by using a *slide* valve, instead of a *poppet* valve. Said patent contains several illustrations of *essentially* the same structure.

In one form (Figs. 2 and 11) train pipe air is admitted by a *by-passage* (containing a check valve) *around* the triple valve chamber, and, in another form (Fig. 12) train pipe air is admitted to produce quick action *through* the triple valve chamber.

Also in one form (Fig. 2) the "partition 9," with the "restricted port B" therein, is *movable* (substantially as illustrated in the Westinghouse Patent in suit), and in other forms (Figs. 11 and 12) the "partition" and "restricted port" therein (B¹ in Fig. 11, B² in Fig. 12) is *stationary*.

This Boyden Patent expressly admits that the two organizations of the structure *are substantially alike*. It says (p. 823, 8th line from bottom of page):

"The restricted passage B for the supply of auxiliary reservoir air when applying the brakes for emergency stops is shown in Figs. 2 and 10, for the purpose of clear illustration, as a small hole through the partition 9; but a special hole or passage is not necessary, as the partition 9 may fit the bushing *b* loosely enough to leave a small space between the rim 9^a of the partition and the wall of the bushing. Such looseness of fit, or the space formed thereby, may constitute the restricted passage, and I have used valves constructed in this manner. The restricted passage may also be formed as a distinct channel in the case, as at B¹ in Fig. 11 or as at B² in 12. *The partition may be located differently from what is shown in Figs. 2 and 11. It is obvious that it may be anywhere on the stem q², so that it is not withdrawn from the bushing when the piston completes its stroke to the left. It may also be stated that the piston may, under certain conditions, be made to serve as a partition. This is illustrated in Fig. 12.*

Fig. 12 illustrates a modification in the construction and arrangement of the parts of a valve embodying my invention. This form of valve, *although differently organized from that shown in Figs. 2 to 11, inclusive, has the same parts, or their equivalents, and has the same mode of operation and produces the same result. The valve shown in Fig. 12 differs from that shown in the other figures chiefly in that the slide valve of Fig. 12 is located on the train-pipe side of the actuating piston, whereas in the other figures it is located on the auxiliary-reservoir side of said piston.* (*Italics ours.*)

In further support of your petitioner's contention that the location of the partition, with its restricted aperture, and the location of the "auxiliary" valve, are not substantially different in the Boyden structure from those illustrated in the Westinghouse structure, your petitioner respectfully represents as follows:

In the Boyden structure in suit the "partition 9" is a fixed partition, located between the auxiliary reservoir and the triple valve chamber, and the "restricted aperture" of said partition restricts the free flow of air from the auxiliary reservoir to the brake cylinder for three purposes:

(a) To hold the high pressure at the back of the triple valve piston, so as to cause the piston to move when train pipe pressure on the opposite side is reduced.

(b) To prevent high pressure from existing under the check valve (in the passage from the train pipe), and thus permit said check valve to open.

(c) To supplement train pipe air with reservoir air (*slowly admitted*).

In the Westinghouse structure the part which acts as a "partition," and "restricted aperture" therein, is a *moving* part instead of a *fixed* part. It is the extended end of the main valve with the restricted port 35.

The operation and effect of that partition, and restricted aperture therein, is precisely the same as the corresponding parts of the Boyden structure, viz. :

(a) To hold the high pressure at the back of the triple valve piston, to cause it to move when train pipe pressure on the opposite side is reduced.

(b) To prevent high pressure from existing under the check valve (in the passage from train pipe) and thus permit said check valve to open.

(c) To supplement train pipe air with reservoir air (*slowly admitted*).

The fact that the partition in one case is a moving one, and in the other case a fixed one; and that in one case it restricts the flow of auxiliary reservoir air *into* the valve chamber, and in the other case *out of* the valve chamber (in *both cases on its way to the brake cylinder*), are shown to be immaterial differences by the express admissions already quoted from the patent to Boyden, No. 481,136.

In support of the second section or paragraph of this petition, your petitioners respectfully represent that, while it is true that the Westinghouse Patent in suit does not describe the restriction of size of the "Port 35" as being

"*for the express purpose of maintaining differential pressures on opposite sides of a check valve which opens in emergencies to admit train-pipe air to the brake-cylinder,*"

and although it is true that the Westinghouse Patent does not, in itself, state such "express purpose," yet the evidence shows that the Westinghouse valves made under said patent were always so constructed, and that the structure could not possibly have been operated to produce "quick action" unless so constructed as to contain a restricted passage through a separating partition (which prevents the *free* flow of auxiliary reservoir air at the time quick action is to be effected), and that this was well understood long prior to Boyden's alleged invention of the "partition" and "restricted port B."

Hence, as your petitioners respectfully represent, the use of a partition, and a restricted passage therein, cannot be claimed as a *novelty* by Mr. Boyden or those acting under him.

In support of the third section or paragraph of this petition, your petitioners respectfully represent that there is no proof in the record that the defendants' device is better, simpler or more efficient than that of Westinghouse, or has ever been introduced into public use on railroads to any considerable extent. But, on the contrary, the proof is that the said Boyden apparatus has never gone into extensive practical use, and is not to be distinguished from that of Westinghouse by reason of any greater efficiency, as will fully appear by reference to the citations from the record (and from public documents) in the brief accompanying this petition.

Your petitioners further represent, as a reason for a rehearing of this cause, upon the points specified in this petition, that the aspect in which this case has heretofore been presented upon the question of infringement has been principally, if not wholly, such as not to call the proofs relating to the specific contentions here presented, to the attention of the Court.

The contentions of the respective parties, as heretofore presented, have been chiefly upon the question whether the Boyden "valve 22" was or was not an "auxiliary valve" which performed the function of the auxiliary valve 41 of the Westinghouse Patent in suit in admitting train-pipe air to the brake cylinder in "quick action."

The contention on behalf of the defendants has been that the said Boyden structure contained only and solely a "main valve" and a "graduating valve," but *no* "auxiliary valve" for "quick-action."

The contention on behalf of the complainant has been that the valve 22 of the Boyden structure was essentially a "quick-action" "auxiliary valve," and not the "main valve" of a triple valve structure.

The question has not been, as your petitioners believe, thoroughly, if at all, argued, whether, *if* it should be held (*as this Court has now held*) that the valve 22 is *in fact* an "auxiliary valve" for "quick-action," the mere location of the same inside of the valve-chamber (on the auxiliary-

reservoir side of the triple valve piston) instead of outside the valve-chamber (or on the train-pipe side of the triple-valve piston), and the consequent incident of a passage for train-pipe air *through* the valve-chamber, instead of *around* it, and the further consequent incident of the location of the part which acts as a "partition" and "restricted port," to prevent free flow of auxiliary reservoir air, at the place where it *enters* the valve chamber, instead of at the place where it *leaves* said valve chamber, constitute material differences of structure or are productive of any materially different results.

Wherefore, your petitioners respectfully ask that this cause be reheard upon the specific question, whether the difference in location of the auxiliary valve 22 of the Boyden structure from that of the auxiliary valve 41 of the Westinghouse structure, and the consequent incident of a passage for train-pipe air through the valve chamber, instead of around it, constitutes a material and substantial difference between the two structures, and whether the difference in location and form of the restricted aperture to prevent the free flow of air from the auxiliary reservoir in "quick action," by locating the same in one case at the point where the air enters the valve chamber on its way to the brake cylinder (as in the Boyden structure), instead of locating the same at the point where the air leaves the valve chamber on its way to the brake cylinder (as in the Westinghouse structure), is a material and substantial difference; or whether either of said differences are sufficient to avoid the charge of infringement.

And your petitioners will ever pray, etc.

(Sd.) WESTINGHOUSE AIR BRAKE CO.,
 By GEORGE WESTINGHOUSE,
 President.
 (Sd.) GEORGE WESTINGHOUSE, JR.

We hereby certify that in our opinion the foregoing petition is well founded in point of law and in point of fact, and is not presented for delay.

FREDERIC H. BETTS,
 GEORGE H. CHRISTY,
 Counsel.



Supreme Court of the United States,

BOYDEN POWER BRAKE COMPANY ET AL.,
Appellants,

VS.

GEORGE WESTINGHOUSE, JR., ET AL.,
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GEORGE WESTINGHOUSE, JR., ET AL.,
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Appellees.

Brief on Petition for Rehearing.

The decision of the majority of the Court rests largely upon a question which does not seem to have been fully, if at all, discussed.

The validity of the claims of the Westinghouse Patent in suit, so far as the question of novelty is concerned, has never been seriously disputed.

The only question has been in regard to the scope of the invention and of the claims.

On the part of the complainant infringement has been presented in two aspects :

FIRST. On the ground that the complainants were entitled to claim broadly, under their second claim, any quick-action triple-

valve apparatus in which the triple-valve piston, by a short or "preliminary" traverse, opened a port from the auxiliary reservoir to the brake cylinder, and which, by a longer or "further" stroke, opened a port from the train pipe to the brake cylinder.

If this position could be maintained, it became unnecessary, under the second claim, to discuss the question whether the valve which opened the train-pipe port was an "auxiliary" valve or not.

The majority of the Court has ruled against this construction of the second claim, and has held that an "auxiliary valve" is an implied element of the second claim.

SECOND: The second contention of the complainants was that the defendants' valve 22 was, in fact, an "auxiliary valve," and that, having all the other elements recited in the combinations of the 1st, 2d and 4th claims, this structure was an infringement of each of those claims.

The contention throughout the case on behalf of the defendants has been a denial that their valve 22 was, in fact, an "auxiliary" valve at all. Their contention has been that the valve 22 was the "main valve" of the triple valve, and that the valve *i, j, k* was a mere graduating valve.

This Court has ruled against the defendants on this contention; but, in the opinion of the majority of the Court, as we read the opinion, the difference in *location* of the defendants' auxiliary valve 22 is believed to be so different from that of auxiliary valve 41 of the Westinghouse Patent, and its arrangement in connection with an air passage *through* the valve chamber, instead of in connection with an air passage *around* the valve chamber, productive of such different results, and involving such a different mode of operation, that infringement has not been made out.

In connection with this issue the Court has held that, although in the Westinghouse Patent the *restricted port 35* is present, and necessarily produces that difference of pressure on opposite sides of the check valve which is essential to the opening of the check valve to admit train-pipe air for "quick action," yet this particular func-

tion of the restricted aperture, being not in terms adverted to by Mr. Westinghouse, is to be regarded as an incident to the form of the structure rather than as expressly in the mind of the designer. Hence it has not been recognized as the equivalent of the Boyden port B, in his partition.

If we are able to show that the *location* of the auxiliary valve inside of the triple-valve chamber, instead of outside of it, is an immaterial difference, then, as we respectfully submit, the two other differences above referred to must necessarily be held to be immaterial also, because they will then be seen to be mere incidents to the change of location of the auxiliary valve.

Thus, if the auxiliary valve be really an "auxiliary" valve, acting as such, but located in the valve chamber, instead of outside of it, then it follows of necessity, and as a mere incident, that the flow of air which it admits, when opened, *must be through* the valve chamber instead of *around or by* it.

One feature follows of necessity from the other.

Again, it also follows of necessity, from the location of the auxiliary valve *in* the valve chamber, that the point of *restriction* of free flow of air from the auxiliary reservoir must be situated to accord with such changed location of the auxiliary valve.

Train-pipe air at reduced pressure is to be allowed to flow past the auxiliary valve when opened. That is the sole purpose of such valve. When the auxiliary valve is open the reduced train-pipe pressure must also be sufficient to open a check valve in the line of flow thus opened. Hence, auxiliary-reservoir air *at higher pressure* must not be allowed to be present in the line of flow opened by the auxiliary valve; the flow of such air *at high pressure* must accordingly be restricted.

If the auxiliary valve is located *in* the triple-valve chamber, of course the free flow of high pressure auxiliary-reservoir air must be restricted *before* that air *enters* the valve chamber, on its way to brake cylinder.

If the auxiliary valve is located *outside* of the valve chamber,

then the free flow of high pressure air need not be restricted until it is *leaves* the valve chamber, on its way to brake cylinder.

Hence, the *place* of restriction of free flow of reservoir air (or location of the restricted port) is merely an incident to the location of the auxiliary valve.

In the Westinghouse structure the restriction is at the point where the reservoir air *leaves* the valve chamber, because the *auxiliary* "quick-action" valve is *outside* of that chamber, and the line of flow of train-pipe air is *around* the chamber—to brake cylinder.

In the Boyden valve, simply because the auxiliary valve is *in* the triple-valve chamber, the restriction of flow of high pressure air must take place *before* it enters the valve chamber, in the line of flow through that chamber to brake cylinder.

There is no other difference between the two structures, and, as we shall now proceed to show, change of location of the valve and of the restricted passage for the flow of train-pipe air is a mere change of location, not production of any new mode of operation, nor of any better or different result.

First Point. On the record, as it stands, defendants can not successfully argue that *in re quick action*, either the *location* of their partition 9, or the presence of a *central passage*, was a material or substantial difference.

As a part of their defense they offered in evidence three Boyden Patents, all of the same date (August 16th, 1892), and consecutively numbered. All of these three patents were asserted to be addressed to a common object, viz.: the production of "quick action" by the admission of train-pipe air, by a valve which, in each case, is *said* to be only the "main valve," whereby, as is said, "an auxiliary valve is dispensed with and 'quick action' by the admission of *train-pipe* air effected by 'momentary differential pressure'" (Rec., p. 821, foot of page).

The first patent of the three, No. 481,134 (Rec., p. 797), related to the first form of defendant's infringing apparatus, about which very little was said at the argument or in the briefs, since it had been superseded by the second form, and the differences between the two were not regarded as very material.

The second patent of the three, No. 481,135 (Rec., p. 809), related to defendants' second form of valve. This is the one which was chiefly discussed at the hearing and is illustrated with substantial correctness in the drawings, and skeleton diagrams next following pages 15 and 16 of the opinion.

The Court has held that the valve 22 of the patent is *really* an "auxiliary" valve.

The third patent, No. 481,136 (Rec., p. 817) relates to another form or construction of quick-action triple valves in which the *alleged* "main" valve is a *slide* valve instead of a poppet valve. Whether it, like valve 22 of Patent 481,135, is not really an "auxiliary valve" need not now be discussed, as such valve is not in issue in this case, but (as will be seen at p. 821, line 5, from bottom of page) it so far resembles the other two as to involve a like exploitation of Boyden's theory of "momentary differential pressures," and (pp. 827-8) of the value of a "partition," and of "a restricted port" therein.

Now a reference to this patent will show that the *location* of the partition 9, with its restricted port B "between the chambers C and D," is *clearly not a matter of importance at all* in respect to producing "*quick-action*" by admitting *train-pipe* air.

In the specification (Rec., p. 819), a little below the middle of the page, Boyden says:

"A restricted or small passage B through the partition 9 serves as an air communication between opposite sides thereof."

Referring now to Fig. 2 of these Boyden drawings (Sheet 2), it will be seen that the partition 9, with its restricted passage B, is *not* "between the chambers D and C," but is located in an extension of the piston stem at the right-hand end of the valve cham-

ber C, and connects with a *by*-passage to brake cylinder (*as in the Westinghouse Patent in suit*). In Fig. 12 (Sheet 5) the partition 9 is a *movable partition*, being the main piston itself (Rec., p. 824, lines 7 and 8), and the restricted port or passage B² is there located in the valve casing.

Mr. Boyden and his company, who introduced this patent, are not in position to argue that *in re quick action* the particular *location* of the partition 9 with its restricted port B, between the chambers D and C, involves any matter of substance, because in one figure (2) they show it located as in the Westinghouse valve, and in another figure located substantially as in the particular Boyden valve in suit (*i. e.*, between chambers C and D).

This patent of Boyden's, No. 481,136, therefore, supports our contention that the *location* of the partition and restricted port is not material in respect of quick-action, and that they may be located at any suitable point, either *between the valve chamber and passage to brake cylinder*, where Westinghouse shows them, or *at the end of the valve chamber next the piston*, as in the particular structure before the Court, or *at the end of the valve chamber furthest away from the piston chamber*, as in the Boyden Patent No. 481,136.

But Boyden, in this patent, goes still further, and specifically admits, what we have always contended for, that the *location of the partition is not material*. Thus (Rec., p. 824, lines 3-5), he says :

"The partition may be located differently from what is shown in Figs. 2 and 11. It is obvious that it may be anywhere on the stem g²," etc.

And again (Rec., p. 824) :

"Fig. 12 illustrates a modification in the construction and arrangement of the parts of a valve embodying my invention. This form of valve, *although differently organized* from that shown in Figs. 2 to 11, inclusive, *has the same parts or their equivalents and has the same mode of operation and produces the same result*. The valve shown in Fig. 12 differs from that shown in the other figures chiefly in that the slide valve of Fig. 12 is located *on the train-pipe side of the actuating piston*, whereas in the other figures it is located *on the auxiliary reservoir side of said piston*" (*italics ours*).

Hence, while we submit that the Court is in error in believing that *the particular location* of the partition 9 is a matter of substance, we can readily see that the error probably arose, as above stated, from a misapprehension of defendants' contention, and a misapprehension which was very liable to arise on account of the exceedingly complicated character of the mechanics of the case.

It will also be seen that in this same Boyden Patent No. 481,136, Boyden has shown that a *central passage*, through the triple-valve piston) and through the valve chamber, is not essential to his theory of "momentary differential pressures," for here will be found in Figs. 2, 5 and 11, a *by*-passage F¹, and a check-valve 26, controlling the flow of train-pipe air through such *by*-passage. And from this fact the inference is fairly obvious that *in re quick-action* there is no substantial or material difference between a "by-passage around the triple-valve chamber and a *through passage*."

Second Point. In respect to the Westinghouse Patent in suit, 360,070, the Court finds :

"The fact, however, that no suggestion is made in the patent of such a function of the restricted port 35, indicates either that none such had been discovered, or that it was not considered of sufficient importance to mention it. Indeed, it seems to have been an after-thought, suggested by the necessity of an answer to defendant's argument, based upon their partition 9. That when an auxiliary valve is opened there must be a difference in pressure above and below the check valve 49, in order to open it, is manifest ; yet, this is rather an incident to the Westinghouse device than the controlling feature that it is made in the Boyden patent " (Opinion, pp. 21, 22.

As to this your petitioners respectfully submit :

1. Differential pressures as a means of brake control had been a known and recognized branch of this art in the automatic system, and such fact abundantly appears from the testimony in the case.

Barnes, Rec., p. 373, fol. 578.

2. The main valve H of the Westinghouse automatic Patent 220,556 (Rec., p. 762) contained a service port s¹ for admitting *aux-*

iliary-reservoir air to the brake cylinder in the ordinary service applications of the brake, such port then being brought to register with the brake-cylinder port C. But when the brake was to be applied with *full force* the further traverse of the piston brought the extreme end of the valve H clear past the brake-cylinder port C, so that the latter was *wide open* for the *abundant* discharge of auxiliary-reservoir air into the brake cylinder.

And this is the feature on account of which the "further traverse" of this valve, as thus constructed, was rendered unsuitable for use for *quick-action* purposes (as was admitted in Mr. Hill's second brief, p. 12).

If this construction had been followed in Patent No. 360,070, *auxiliary reservoir* air would enter the brake cylinder *as freely and as fast as train-pipe* air could pass through the emergency port 42 of 360,070, and the latter, being of *less* pressure, "*quick-action*" would be impossible.

Hence, Mr. Westinghouse, in devising the apparatus of 360,070, made an extension of the extreme end of the main valve (called H in 220,556), and in that extension he made a small or restricted port 35; and this fact is specifically referred to by him in his specification (p. 3, lines 4-19), where he first enumerates the leading operative parts of the triple valve of 220,556, and then says (lines 9-12):

"But *under my present invention these are supplemented by a port 35, leading from the end of the valve adjacent to the opening of the chamber 24.*"

The port 35 is, therefore, a new feature introduced for some purpose in devising the quick "action" invention.

Next, what does the Patent 360,070 say about the relative sizes of the ports 35 and 42?

Of the port or passage 42, it says (p. 4, lines 34-42):

"Not only is there a passage of *considerable size* opened from the brake pipe on each car, whereby the pressure is more quickly reduced, but the air so discharged is utilized in the performance of preliminary work, it being found in practice that the air so taken from the pipe will exert a pressure of about twenty-five pounds in the brake cylinder" (*italics ours*).

Next, we have the following directions as respects the port 35 (p. 4, lines 43-67):

"When the piston 12 arrives at the extremity of its stroke, as above specified, *the supplemental port 35 of the slide valve 14 is brought into communication with the port 33 and passages 22 and 16, which serves to discharge the reservoir pressure into the brake cylinder, thereby augmenting the pressure already exerted in the brake cylinder by the air admitted from the main air pipe.* * * * The feed-opening for the admission of air from the *auxiliary reservoir* to the brake cylinder *is purposely made of comparatively small diameter*, it having been determined by experiment that the initial application of the brakes should not be made with maximum force, and this opening may be made of such size as to apply the brakes exactly in accord with the requirements of the most efficient work." (*Italics ours*).

Hence it is submitted that the Patent 360,070 clearly sets forth in substance the following facts:

(1) That the port 35, with the extension in which it is made, was added to the automatic main valve of 220,556, with reference to and for the express purposes of quick action.

(2) That the port 35 (for reservoir air) is "purposely made of comparatively small diameter."

(3) That the port 42 (for train-pipe air) is to be made of "considerable size."

And these ports being so made, it fully appears from the testimony that "differential pressures" *will certainly be attained*, and that *such fact was well known in the art* (*Barnes, Rec.*, p. 362, fol. 560 (*b*); p. 367, Q. 670; p. 373, p. 371, par. 1; p. 386, fol. 599; p. 406, Q. 701; p. 445, x-Q. 827; p. 453, x-Q. 852. *Newbury, Rec.*, p. 157, Qs. 199, 200; p. 160, Q. 202; p. 163, Q. 205; p. 212, x-Qs. 248-252. *Westinghouse, Rec.*, p. 276, fol. 424; pp. 285, 286, fol. 439; p. 287, Q. 417; p. 289, Q. 422).

Hence, it is submitted that the construction and operation referred to had been "discovered" by Westinghouse; that in respect thereof, sufficient "mention" was made to enable others skilled in the art to make and use it; that it should not be regarded as an "afterthought" nor a mere "incident to the Westinghouse device," and that as to these matters the Court was inadvertently in error.

Defendants did not deny the actual existence of this relation of the ports in the Westinghouse quick-action triple of 360,070. Nor did they deny that the flow of air from train pipe and auxiliary reservoir into the brake cylinder would, as a matter of fact, take place accordingly. Their leading expert, Mr. Church, says unhesitatingly in his direct examination, that the Westinghouse valve of 360,070 contains provisions for a *larger flow of train-pipe air* to the brake cylinder, in emergency use, than from the *auxiliary reservoir* to the brake cylinder.

This is merely the converse of the proposition that Westinghouse restricts the flow of auxiliary air.

Thus, Church says of 360,070 (Rec., p. 605, fol. 980) :

"The passages and ports through which *train-pipe* air is conducted, are *relatively larger* than those through which *auxiliary* air is conducted to the brake cylinder ; consequently, the flow of *train pipe* to the brake cylinder *would precede auxiliary reservoir air, and a relatively larger volume would pass in a given time*" (Italics ours).

Mr. Church tries to belittle the effect of this rapid admission of train-pipe air, but the *fact* is clearly admitted.

(See, also, the further testimony of the same witness in Re-d. Q. 239, Rec., pp. 656, 657, fols. 1059, 1060.)

It is undoubtedly true, however, that in the specification of 360,070—and this is perhaps what the Court had more prominently in mind—the particular operative or co-operative relationship between the restricted port 35 and the check valve 49, whereby, in consequence of the holding back of auxiliary reservoir pressure at the port 35 (except in small amount), train-pipe air at a *less* pressure will lift the check valve 49 and pass freely to the brake cylinder, is not specifically stated as a matter of importance.

But the *fact* remains—and by the facts, as we respectfully submit, we should be judged—that the relationship thus referred to *does actually exist* in the Westinghouse apparatus as shown and described, and also exists as a mechanically co-operative relationship, for the useful purposes for which the apparatus was designed. And it is still further a fact, as clearly appears from the citations made from the patent as above, that the devices thus referred to came

into this co-operative relationship, not *by accident*, but *were made so by design*, to the end that the hitherto unattained purposes and functions of quick action, in a *new kind* of train control, might be accomplished.

Indeed, as we understand, the Court has found the fact to be as we have thus represented. For it is admitted in the above extract from the opinion of the Court:

"That, when the auxiliary valve is opened, there *must be* a difference of pressure above and below the check valve 49 in order to open it, is manifest" (italics ours).

This being true, does it not necessarily follow that suitable means for securing "differential pressures" *actually existed* in Westinghouse's apparatus?

And, if it existed, it must, to the extent and for the purposes of its existence, be a "controlling feature" in the use of the Westinghouse valve, and as much so as in the Boyden.

Hence, if it actually existed, as the Court has found, in operative form in Westinghouse, any failure on the part of Westinghouse to fully appreciate or even to state its importance *cannot*, as we submit, *by any rule of law, inure to the credit of Boyden*.

Boyden is not entitled to high rank as an independent inventor, merely because he has *set forth* in his patent something as a "controlling feature," which, in substance and effect, was already present, and was, in fact, a "controlling feature" in Westinghouse's previously-existing valves, no matter who invented them, nor how defectively or imperfectly their functions were *described*, provided only their construction and operation were previously known.

Third Point. Your petitioners also submit that error of inadvertence also appears in the following finding of the Court:

"There is no partition [in Westinghouse] in the proper sense of the word—certainly none located, as in the Boyden device, between the chambers D and C, and no aperture in such partition opened for the express purpose of maintaining this differential pressure" (Opinion, p. 22).

If "partition" means something which mechanically affects

separation—and the mechanical test is the usual standard of judgment in patent cases—then it is believed that the finding that Westinghouse has no partition “in the proper sense of the word” is erroneous.

The extension on the end of the main valve, above referred to, with its restricted port 35, (which the Westinghouse Patent in suit expressly says is a “supplement” to the older construction of Patent No. 220,556), is *mechanically* as much a “partition” to effect separation between the auxiliary reservoir and the brake cylinder as is the Boyden partition 9, with its restricted port B; Nor in this regard does it make any substantial difference *in respect of separation that at the time when separation becomes important* the Westinghouse partition is *movable* and the Boyden partition is *fixed*.

Both devices equally and in substantially the same way—that is, by blocking, restricting or impeding the flow from auxiliary reservoir to brake cylinder, except through the restricted port 35 of the one or B of the other—secure the same results, and in the same way. We have shown, also, that the fact that a “partition” with a restricted port therein is *movable* rather than *fixed* is admitted by Mr. Boyden himself, in Patent No. 481,136, *to be an unsubstantial difference*, because he illustrates the invention of that patent in one form (Figs. 11 and 12) with a movable partition (9) substantially like Westinghouse’s.

Fourth Point. Your petitioners, therefore, respectfully submit that the Court inadvertently erred in supposing, as it did, that *the location* of the Boyden partition 9 “*between the chambers D and C*” is a material difference, or a difference of substance—that is, as respects “*quick-action*.” No such contention was made in the oral arguments of defendant’s counsel.

Defendants’ position was this: That their valve 22 was *not* an “*auxiliary*” valve, but was *the main* valve; and, in support of *this* contention, they emphasized the location of their partition 9—that it was *so* located that it provided for the admission of *auxiliary*

reservoir air along with *train-pipe* air to the brake cylinder, and that as the admission of *auxiliary reservoir* air was in the old automatic brake a function of the *main valve*, therefore, this particular location of the partition 9 tended to make their valve 22 the "*main*" valve, and not an "*auxiliary*" valve. This, as we recall the argument, was the substance of their contention.

But the Court has found, in substance, as we read the opinion, that defendant's valve 22 is, in fact, an "*auxiliary*" valve, and a "quick-action" valve, notwithstanding the fact that, when it is opened in emergency use for the admission of *train-pipe* air, some auxiliary reservoir air—i. e., as much as can pass through the restricted port B—also passes through with it.

Hence, the Court having found, against the contention of defendants, that the location of the partition 9 does not have the effect of converting the valve 22 into a "*main*" valve, but leaves it still an "*auxiliary*" valve, it would seem to follow that the mere location of the partition 9 ceases to be a material fact in the case, especially in respect of quick action. Putting the partition 9 with its restricted port B between the chambers D and C, or putting it at any other point in the line of flow from auxiliary reservoir to brake cylinder, while to a limited, but insignificant, extent it may affect valve 22, does not in any manner, nor to any extent, affect the essential features of the structure, as they are combined to produce "quick action."

A similar argument holds also in reference to the "central passage" which defendants have provided through their triple-valve piston, as compared with the Westinghouse by-passage. Defendants relied on their central passage in support of their contention that their valve 22 was a "*main*" valve, and not an "*auxiliary*" valve.

The Court has found this fact against them.

Hence, it would seem to follow that, in *re quick action*, the difference between a *central* passage and a *by-passage* is not a difference of substance.

Careful attention to the purpose and mode of operation of the

separating partition and its small port will, we submit, show that the *location* of such "restricted port" is not substantial, provided only it be located somewhere in the line of flow of air from the auxiliary reservoir to brake cylinder, and at *any* point in such line of flow, where it accomplishes the following objects, viz. :

(a) Restricts the flow, so that the reservoir air will be at *high* pressure behind the triple-valve piston, to move it when train-pipe pressure is reduced ;

(b) Restricts the flows, so that such auxiliary reservoir air will *not* be at high pressure behind or under the check valve in the passage from train pipe.

(c) Admits reservoir air *slowly* as a supplement to train-pipe air.

These are the only purposes of the "restricted port," and they can all be as well accomplished in Westinghouse's location as in Boyden's, and *vice versa*.

Fifth Point. We submit, also, that the Court inadvertently erred in finding that Mr. Boyden,

"has made a more perfect brake than the one described in the Westinghouse Patent" (Opinion, p. 22).

This error was doubtless made through reliance on the statements of counsel at the argument ; for with a good knowledge of the contents of the record, and after a careful re-examination thereof, we are unable to recall or to find any testimony which can support such a finding. And so far as the proofs go, they are to the opposite effect.

Mr. Boyden is the only witness for the defense whose testimony even approaches the subject (Rec., pp. 515, 516, fol. 844) ; and he does not allege, nor even intimate, that his brake is any *better* than the Westinghouse. It is as certain as anything can be, that he would have said so, if he could. His silence certainly fails to support the finding of the Court.

Elsewhere in defendants' proofs, this matter is never referred to at all.

Nowhere does it appear that any considerable number of the Boyden brakes were ever actually sold, and still less does it appear that they were ever used, either successfully or otherwise.

Two of complainants' witnesses, Kidder and Nellis (Rec., pp. 425, 433), got together three cars (fol. 678) equipped with the Boyden brake, and tried them experimentally to see whether the Boyden valve 22, in actual use, had the operation of a *main* valve, or an *auxiliary* valve. They found it to be the latter.

Aside from this, the record contained no proof whatever as to the actual operativeness of the Boyden brake.

True, it worked on a short three-car train, but this proves nothing as to its efficiency *in emergencies on a long fifty-car train*. The old "automatic" without "quick-action," met all the requirements of use on short trains. It was only when *long* trains are to be handled that "quick-action" becomes an element of commanding importance.

The record is entirely silent as to the efficiency of the Boyden brake on a *long train in an emergency*. There is no proof whatever that it was ever so used or even tried. For aught that appears, if it had been subjected to the rigid tests and high requirements of the Burlington trials, its operation would have been found to be quite as defective for the practical requirements of quick action as that of the Westinghouse.

But as against any inferences favorable to the Boyden brake which may be drawn from the record we show by our testimony that the Boyden device is seriously defective in the proportioning of its ports and passages, and this testimony is not replied to.

Westinghouse, Rec., pages 296, 297, Q. 447.

If it is ever admissible to supply a paucity of record proof by reference to official reports of a governmental department, the present would seem to be such a case.

The Government of the United States publishes each year in its official reports of the Interstate Commerce Commission the number of railway cars then furnished with power brakes, as

reported to them by the railway companies, and the designating name of each.

We suppose that this Court may (at least in a matter not specifically contested on proofs) take notice of such "Public Documents" (*New York Indians vs. United States*, decided at this Term, April 11, 1898).

We collate from these reports the following tabular statement (with references to pages):

Report.	Boyden.	Westinghouse.
1890, page 36.....	86	144,085
1891, " 46.....	184	178,492
1892, " 28.....	282	245,276
1893, " 26.....	796	287,703
1894, " 26.....	1,690	315,729
1895, " 28.....	1,491	345,836
1896, " 28.....	439	428,805

The report for 1897 is not yet published.

These figures would seem to indicate that the Boyden brake has not recommended itself in practice, in view of the showing that the number of cars equipped with it has decreased from the maximum of 1,690 in 1894 to 439 in 1896—a falling off of over 70 per cent. in two years.

But, if the Court based its conclusion on the defective action of the apparatus of 360,070, when first tried at Burlington in 1887, then we may suggest in reply:

1. That such defective action arose largely from an improper proportioning of ports and passages, not of the valve itself, but of the "accessory parts" used in connection therewith, which defects, however, were corrected long before Boyden took up the subject at all, and thereafter this brake of 360,070 worked well.

Westinghouse, Rec., pp. 151, 152, fol. 228.

Westinghouse, Rec., p. 155, Qs. 190, 191.

2. Newly-invented apparatus, especially of a complicated character, rarely works perfectly on its first trial.

3. If the number of valves in use be adopted as a test of comparative merit between the Westinghouse and Boyden, then the Westinghouse valve of 360,070 is the "more perfect" valve.

Between *two and three thousand* of these very valves were sold to three leading Western roads and were still in use when the testimony was taken.

Westinghouse, Rec., pp. 305, 306, x-Q. 485, 486.

Also, about three or four hundred of these same valves of 360,070 were sold to the Baltimore and Ohio R. R. Co., and were used in passenger-train service for about two years, when the Westinghouse Company replaced them with their standard form of valve, No. 376,837.

Westinghouse, Rec., 304, 305, x-Q. 477-479.

Sixth Point. We respectfully submit, therefore, that an opportunity should be given for a rehearing upon the particular question whether the changed location of defendant's "auxiliary valve" and "partition" and "restricted port" is sufficient to avoid the charge of infringement.

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Counsel for Westinghouse Air Brake Company.

[11091]
[11093]

847 403 99 JAN 20 1896

Supreme Court of the United States

Filed Jan. 20, 1896.

IN THE MATTER OF THE PETITION

OF

GEORGE WESTINGHOUSE, Jr.,

AND

THE WESTINGHOUSE AIR BRAKE COMPANY

FOR A WRIT OF CERTIORARI.

BRIEF FOR BOYDEN BRAKE COMPANY.

CONTRA THE PETITION.

LYSANDER HILL,

EDGAR H. QANS,

Of Counsel for Boyden Brake Company.

Supreme Court of the United States

WESTINGHOUSE AIR BRAKE COMPANY,	}
<i>et al,</i>	
PETITION FOR A WRIT OF CERTIORARI.	}
VS.	
BOYDEN POWER BRAKE COMPANY,	
<i>et al.</i>	}

Sur Petition of the Westinghouse Air Brake Company, *et al*, for Writ of Certiorari to United States Court of Appeals for Fourth Circuit.

This is a petition for a Writ of Certiorari to bring Nos. 131 and 134, decided in the United States Court of Appeals for the Fourth Judicial Circuit, before the Supreme Court for its review and determination.

BRIEF IN OPPOSITION TO THE PETITION.

In this petition are twelve assignments of variance and error. An analysis of these assignments shows that they may be grouped into three classes.

1. Variances between the decision of the Court of Appeals for the Fourth Circuit and the decision of the Court of Appeals for the Second Circuit on the same subject matter. These are stated in assignment 1.

2. Variance between a ruling by the Court of Appeals for the Fourth Circuit and the decisions of the Supreme Court on the effect of the phrase "substantially as set forth." And variance with the Circuit Court of Appeals of the First Circuit on the effect of erasure from the original specifica-

tion. These variances are alleged in the fourth and fifth assignments. They really could be grouped with simple assignments of error, as the assignments *are more properly assignments of error* than assignments of variance.

3. Assignments of error. These are described in the third assignment, wherein error is alleged in the ruling of the Circuit Court of Appeals for the Fourth Circuit on the *weight of evidence* as connected with the practice of the Patent Office, and in the second, sixth, seventh, eighth, ninth, tenth, eleventh and twelfth assignments, wherein error is alleged in the rulings of the Court on matters of law and fact concerning the construction and validity of the patent in suit, and its infringement.

We have grouped the assignments into these three classes, because it seems manifest from the uniform decisions of this Court, as hereinafter pointed out, that the second and third classes just mentioned, furnish no ground for the application of the Writ of Certiorari, **AND THAT THE ONLY QUESTIONS TO BE REALLY CONSIDERED UPON THIS APPLICATION ARE THOSE ARISING UNDER THE FIRST CLASS OF ASSIGNMENTS, e. g.,** wherein variances are claimed to exist, as to subject-matter of the litigation, between the rulings of two appellate Courts whose decisions in patent cases are ordinarily final.

The brief for the petition discusses only the first five assignments.

GROUNDS FOR CERTIORARI UNDER THE ACT OF 1891.

This Court has described at length the class of cases which it will review by Writ of Certiorari, in several cases, to wit:

American Construction Co. vs. Jacksonville Railway Co., 148 U. S., 382.

Lau. Ow. Bew's Case, 141 U. S., 583 ; 144 U. S., 55.

In re Woods, 143 U. S., 202.

Columbus Watch Co. vs. Robbins, 148 U. S., 270.

From an examination of these cases the following principles may be deduced as governing all applications for certiorari of this character.

1. The object of the act was to relieve the Supreme Court of the overburden of cases, and to accomplish this to transfer a large part of its appellate jurisdiction to the Circuit Courts of Appeals.

2. The act is to be uniformly construed so as to promote this purpose, and especially in those classes of cases wherein, as in patent cases, the judgment of the Circuit Court of Appeals is, by this act, *made final*.

3. The power to bring up cases by certiorari is a branch of the jurisdiction of the Supreme Court "which should be exercised sparingly and with great caution, and only in cases of peculiar gravity and general importance, or in order to secure uniformity of decision."

Am. Construction Co. vs. Jacksonville Ry. Co.,
148 U. S. 382.

From this analysis it is apparent that a certiorari writ will not be granted unless the cause "is of peculiar gravity and general importance," or unless there is a substantial variance of decision on the *same* subject matter and under the same conditions. We will discuss this case under these headings.

(A.)—CASES OF PECULIAR GRAVITY AND GENERAL IMPORTANCE.

Independently of the questions of variance which we will discuss hereafter, there are no questions in this case different in any respect from those which usually arise in patent cases. There is no unusual, extraordinary or fundamental question, even on patent law, involved in any of the assignments of error. None of these can, by any possibility, be brought within the meaning and scope of the phrase, "cases of peculiar gravity and general importance."

What did this Court mean when they declared that in "cases of peculiar gravity and general importance" they would review a case by certiorari, even though otherwise made final by the Act of 1891?

Evidently the gravity and importance of the case is to be found in the *nature* of the question, and not in the mere

sum of money involved, or in the extensive use of the invention. If it had been the intention of the Act to give a hearing in the Supreme Court to such patent causes as involved large sums of money, such intention would have been expressed and the amount fixed. But by the Act all patent causes are finally decided in the Circuit Courts of Appeal. Nor can a patent which is used in every State in the Union have any right to a hearing in the Supreme Court which is denied to a patent with less extensive use. No such discrimination would be practicable. A patent of limited use to-day might be in universal use next year.

An examination of all the cases shows that in the entire history of this Court since the Act of 1891 was passed, *not a single application for a certiorari in a patent case has been granted*, when the only questions involved were such as usually arise in patent cases, and such as arise in this case.

In the following cases the writ was denied:

Sawyer Man Co. vs. Edison Electric Co., 11 U. S. A., 712; 149 U. S., 785.

This case involved the Edison incandescent electric lamp, which is in extensive use.

Stewart vs. Smith, 17 U. S. A., 217; 154 U. S., 519.
Case of design patent.

Singer Sewing Machine Co., vs. Brill, 7 U. S. A., 601.
Sewing machine patent.

The David Bradley Mfg. Co. vs. The Eagle Mfg. Co., 18 U. S. A., 349; 154 U. S., 500.

Improvement in cultivators.

These were cases of valuable patents, several of them of *very extensive use through all judicial circuits*, involving the investment of large sums of money. But the application was denied in each case because no questions of "peculiar gravity or general importance" were involved.

It appears that in two patent cases only, since the Act of 1891, has this Court granted the writ of certiorari, and in these the special reasons for the Court's action are apparent.

In the case of Grosvenor vs. Dashiell, the patent involved was No. 425,584, granted to Samuel Seabury for improvement in breech-loading cannon. The bill stated an ordinary case involving questions of the validity and infringement of a patent, but alleged also that Dashiell, who was an officer of the United States Navy, was connected with the Bureau of Ordnance of the Navy Department, and that he conspired with Commodore Folger, who was in charge of the department, to use the complainant's invention and deprive the patentee and his assignees of the benefits and royalties secured by the patent.

This case in the Circuit Court of Appeals for the Fourth Circuit did not turn on any question of patent law, but upon the very grave and important question as to the right of the government in its sovereign capacity to use a patented device in the manufacture of implements of warfare indispensable to the armament of its vessels of war, without being liable to be stopped by the patentee by injunction. As Circuit Court Judge Goff decided :

"We do not think that contending patentees, striving between themselves and those interested with them, as to the validity of their respective letters patent, should be permitted to close the arsenals, ordnance shops and navy-yards of the United States by injunctions issuing out of their litigation, thereby frustrating the designs of the government, rendering inoperative the legislation of Congress germane thereto, and causing great loss of the public funds appropriated by Congress in execution of the same."

Hence, it will be perceived that though this question arose in a patent case, it was not a question of patent law at all, but was an important governmental question, in which the United States was vitally interested.

The only other case in which a patent was involved, and in which a certiorari was granted, is the case of Vulcan Iron Works vs. Samuel R. Smith et al.

In this case the question involved was the *jurisdiction* of the Circuit Court of Appeals. On the question of juris-

diction, the decisions of the Circuit Court of Appeals of various circuits were at variance; and this variance was vital to the rights of the petitioners, for it appeared that if the case had been decided in one circuit the decree would have been affirmed; but as it was decided in the other, the decree was reversed.

This case presented two vital and important questions: First, the jurisdiction of the Circuit Court of Appeals; and second, an absolute variance between the circuits on this jurisdictional question; and upon the decision of these questions the rights of the petitioners in the case depended. Neither of these questions are mere questions involving patent law.

What extraordinary or unusual question "of peculiar gravity and general importance" is presented by the record in the *present* case? There is no governmental question; no question of jurisdiction; no issue in which any one is especially interested except the parties litigant. If the writ of certiorari should be granted in this case, on the ground we are now discussing—peculiar gravity—it would be an innovation upon the established practice of this Court, and no good reason can be perceived why like writs should not issue in any subsequent cause at the instance of any litigant who felt that his patent had not been properly construed by the Circuit Court of Appeals.

If the shoe were on the other foot, and we had secured an injunction against the Westinghouse Company, and this injunction had the practical result of obstructing interstate traffic, or the carrying of the mails with safety, then, indeed, an unusual question would arise which might call the discretionary power of this Court into action.

But the only practical question in dispute in this case was whether the Westinghouse Company should have the sole monopoly in supplying the railroad companies with "quick-action automatic air-brakes," or whether the Boyden Company should have the right to supply their own special contrivance in competition. This is, therefore, a mere *private litigation* embracing no question of "peculiar

gravity or general importance ;" and on this ground, unless there is something in the question of variance, the application for the writ of certiorari should be denied.

(B).—VARIANCE.

The petitioners, however, rest their case mainly on the ground of an alleged variance between the decisions of the Circuit Court of Appeals for the Fourth Circuit and the Circuit Court of Appeals for the Second Circuit on the same subject matter—to wit, Claim 2 of Patent 360,070.

In their petition they cite four decisions in the Circuit Court and the Circuit Court of Appeals of the Second Circuit, as follows :

Circuit Court, Judge Townsend, 59 Fed. Rep., 581.

Circuit Court of Appeals, Judge Shipman, 63 Fed. Rep., 962.

Circuit Court, Judge Lacombe, 65 Fed. Rep., 99.

Circuit Court of Appeals, per curiam, 69 Fed. Rep., 615.

Petition, pp. 3-4, par. 8-12.

The patent here in controversy, 360,070, was not in issue in the first two decisions.

The variance alleged in the petition and relied upon in the brief of complainants, is between the decision of Judge Lacombe, as affirmed, per curiam, in the Second Circuit and a decision of the Circuit Court of Appeals for the Fourth Circuit.

In their brief the petitioners argue that a certiorari should be granted under the Act of 1891 :

(1). In cases of variance between decisions of the Circuit Court of Appeal of different circuits in adjudications upon the same patent.

(2). When the patent involves rights of sufficient importance to justify the intervention of the Supreme Court.

The importance of the invention embraced in patent 360,070 is described in their brief, pages 2-7; here it is made to appear that the patent in suit is one of great

importance and "value in promoting the public interest," and in answer to the averment in the petition on page 6, to the effect that the *device of the patent in suit is in use on 400,000 freight cars*; it should be stated that the testimony shows the device of this Patent No. 360,070 is not in use and has not been made since 1887. On this point the testimony of H. H. Westinghouse the General Manager of the Westinghouse Air-Brake Company is conclusive; see Transcript of Record, page 224.

"165 X-Q. Does the Westinghouse Catalogue 1890, "the one now in use, contain any plates or illustrations of 'quick action triple valves' like that shown in the drawings of the Letters Patent No. 360,070?"

"A. It does not.

"166 X-Q. Please state whether or not the type or form of 'quick action triple valve,' which is shown in the drawings of the Patent No. 360,070 was ever illustrated in any catalogue issued by the Westinghouse Air-Brake Company?"

"A. I believe it was not.

"167 X-Q. Is the Westinghouse Air-Brake Company now making and selling 'quick action triple valves' of the type or form shown in the drawings of the Letters Patent No. 360,070?"

"A. They are not."

This device is not in use now, and was abandoned after the trials at Burlington, Iowa, in 1887, because it was *practically unsuccessful*.

The device which *is* in extensive use is the one covered by *another* Patent, No. 376,837, not here in suit. We submit this disposes of the pretension that the patent in controversy is one of great importance and used on 400,000 cars.

The statement of petitioners as to the character of the variance which is ground for a certiorari, is found in the brief, pages 1, 2.

On page 1 of their brief they say:

"When Congress passed the Act of March 3, 1891, establishing Circuit Courts of Appeals, and

in patent cases, made their decisions final, it was anticipated that sooner or later conflicting and irreconcilable decisions would or might be rendered. And obviously, as the effect of such conflicts, a patent valid in one circuit might be invalid in another circuit; and an act of infringement, if committed in one circuit, would be enjoined as wrong, and if persisted in, would be punished as a contempt of court; while in another circuit the same act would be held to be perfectly careful, proper and innocent."

And the petitioners state the alleged variance in their brief, pages 7, 8, as follows:

"The Circuit Court of Appeals for the Fourth Circuit, in the opinion rendered by his Honor, Judge Hughes, says that this Claim 2 is invalid, or, to use the exact language employed, that it is 'fatally defective.'"

Petitioners brief, p. 7.

"This ruling is directly in conflict with a holding of the Circuit Court of Appeals for the Second Circuit. It was there held that this claim 2 of patent 360,070 was valid, and the action of the Court below in awarding an injunction under this claim was affirmed. And this injunction is still in force in the Second Circuit."

Petitioners' brief, p. 8.

From this statement of the alleged variance, the petitioners attempt to impress this Court with the idea that the adjudications of the Courts of the Second and Fourth Circuits on claim 2 of patent 360,070 are so conflicting that if a suit were brought against the Boyden Brake Company, et al, in the Second Circuit the defendants would be enjoined as infringers, whilst if the suit were brought against them in the Fourth Circuit, the bill would be dismissed. This is their contention, stated practically, though they do not use this precise language; *and they are obliged to make out a variance of this kind in order to have even a possible chance for procuring a certiorari.*

Because, if the variance is only formal and trivial and of such a character that no matter which decision is taken, the *result as to the defendants would be the same*, manifestly no such difference of adjudication would exist as would call for the intervention of this Court.

We respectfully insist that the petitioners' brief, in so far as it alleges a variance materially affecting the petitioners' rights against the defendants', is not candid, but is directly misleading.

This Court will find on examination that there is no real variance at all between the two Courts of Appeal, and that the *apparent* variance has nothing in the world to do with the petitioners' rights as involved in this suit.

This alleged variance, even if it exists, is purely formal and immaterial, and the absolute immateriality and triviality of the alleged variance can be demonstrated by an examination of the claims of the patent and a comparison of the decisions which are alleged to be at variance.

In order to better understand the subject matter to which the claims relate, the air-brake will be briefly explained.

MECHANISM OF THE AIR-BRAKE.

The automatic air-brake consists of a train-pipe extending along under the cars, an auxiliary reservoir, a brake-cylinder and a triple valve on each car; the triple valve governing the flow of air between the other devices. The patents on the foregoing devices expired several years ago, and they were public property at the time of filing the bill in this case. The "triple valve," which was old, is *colored blue* in the cuts at the end of this brief. In the year 1887, Westinghouse added to the old triple valve "*an auxiliary valve device*," and procured this patent, 360,070, for the same. This auxiliary valve device of 360,070 is *colored red* in the cut representing this patent at the end of this brief.

Claims 1, 2 and 4, of Patent 360,070, issued to George Westinghouse, Jr., were the special subjects of the suit.

Claim 1 reads:

"In a brake mechanism, the combination of a main air-pipe, an auxiliary reservoir, a brake-cylinder, a triple valve, and **AN AUXILIARY VALVE** device actuated by the piston of the triple valve and independent of the main valve thereof, for admitting air in the application of the brakes directly from the main pipe to the brake-cylinder, substantially as set forth."

In this claim only the part in bold type was new (colored *red* in cut); the triple valve parts of the combination were old (colored *blue* in cut).

It will be observed that the "*auxiliary valve device*" is the only new element, and that it admits the air from the main pipe to the brake-cylinder. The piston is old and merely actuates the "*auxiliary valve*," and is not the element that does the "*admitting*."

The Circuit Court (Judge Morris) and the Circuit Court of Appeals for the Fourth Circuit both decided this claim to be valid, but they also both decided that there was no infringement, as the defendant's mechanism did not contain an "*auxiliary valve device*," but that Boyden accomplished the same result by giving the *old* main valve of the old triple-valve a *double* function without using any "*auxiliary valve device*" whatever.

Claim 4 is substantially the same as Claim 1. As to these two claims the Circuit Court (Judge Morris) decided, and its decision was affirmed on appeal—

"As by the explicit terms of Claims 1 and 4, Westinghouse has restricted himself as to those claims to an *auxiliary valve* independent of the main valve, I hold that the defendant does not infringe those claims."

Both claims contained as part of the combination "*an auxiliary valve*," and this auxiliary valve was the new thing which made the combinations patentable. The complainant received, therefore, full protection from the Circuit Court of Appeals against any one using such brake

mechanism with an "*auxiliary valve*," but the Court decided, *as matter of fact*, that the device of the Boyden Company did *not* contain any "*auxiliary valve*," and therefore did not infringe the claims Nos. 1 and 4 of the Westinghouse Patent. No variance is alleged as to this part of the decision.

The alleged variance appertains to Claim 2, which reads :

"2. In a brake mechanism the combination of a main air-pipe, an auxiliary reservoir, a brake-cylinder and a triple-valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake-cylinder, and which, by a further traverse, *admits air directly from the main air-pipe to the brake-cylinder*, substantially as set forth."

All the parts or mechanism named in this claim, including the "further traverse," are old and are shown in blue in the illustrations; the part of the claim in *italics* is a mere *functional* recital or result, and is all that is new in the claim.

It will also be observed that the element, an "auxiliary valve," which is described in the specification as *necessary* to admit the air from the "main air-pipe to the brake-cylinder," is not included in terms in Claim 2 as it is in Claims 1 and 4.

Now, how did the Appellate Courts for the Fourth and Second Circuits respectively treat this claim?

The Court for the Fourth Circuit held this claim *in the form it has*, to be defective. They said:

"We think that when Claim 2 of 360,070, in its language describing the action of that device, fails to describe any means by which the extreme traverse of the piston produced it, declaring merely that the piston, '*by a further traverse, admits air directly from the main air-pipe to the brake-cylinder*,' it was fatally defective, claiming only a result which was public property and not identifying the specific means (his own property) by which the result is achieved."

The Court for the Second Circuit affirmed Judge Lacombe's opinion, *per curiam*.

Judge Lacombe construed this claim valid, not in the form in which the claim is expressed, but by reading into it the mechanical means, to wit: *the auxiliary valve device*.

In order to clearly understand Judge Lacombe on Claim 2, it is necessary to advert to his treatment of Claim 1. In regard to Claim 1 Judge Lacombe says:

"The means for actuating the auxiliary valve device is stated in the claim to be 'the piston of the triple-valve,' and the way in which it acts, as shown in the patent, is by direct impingement upon the stem of the auxiliary valve device."

A little further on in his opinion Judge Lacombe says as to Claim 2:

"The discussion of the first claim applies equally to this one. In the first claim actuation by the piston of the triple valve was made an element. In this claim (2) the inventor more *closely limits the mode of such actuation*. It is to be by a 'further traverse' of that piston."

The Court will remember that the first claim contained an "*auxiliary valve*" as an essential part of the patented combination—an auxiliary valve *actuated by the piston*. Judge Lacombe, it will be seen, construes the second claim to be narrower than the first, in this, that whereas, Claim 1 contains an auxiliary valve actuated by the piston, Claim 2 contains an auxiliary valve actuated by "*the further traverse of that piston*." The decree in the New York case was for the complainant because the defendant in that case did use the "*auxiliary valve*."

Now we are in a position to see the *precise effect* of the alleged variance. What possible difference can it make *in the determination of this case* to the petitioners, whether, on the one hand, Claim 2 is declared "*fatally defective*" because it *fails to describe any means* and describes only the result, and thereby the patent fails to hold the defend-

ants, or, on the other hand, is declared valid by reason of *reading into* the claim an element these defendants do not use, an "auxiliary valve actuated by the further traverse of the piston," and thereby also fail to hold the defendants? Whichever view of this *alleged* variance is taken, the defendants, the Boyden Company, are not infringers. As the determination of *this case* would be the *same* under either ruling of Claim 2, there can be no *real* variance, and as the case stands justice has been done.

If Claim 2 is declared "fatally defective," Claim 1 still stands, and if it is declared valid by reading in "an auxiliary valve actuated by the further traverse of the piston," the claim "is more limited" than Claim 1, as held by Judge Lacombe. In Claim 1 the petitioners have more than in Claim 2, even as construed by the Circuit Court of Appeals for the Second Circuit. How are the petitioners hurt by the alleged variance?

By the construction held in the Second Circuit Claim 2 contains an "auxiliary valve." There was not the slightest contention in that case that Claim 2 did not contain an auxiliary valve. On the contrary, since defendants' infringing device (the New York Company) *in that case* did contain an auxiliary valve, there was every reason to *read* an auxiliary valve into the complainant's claim, as was done by that Court.

Counsel for the Boyden Company were perfectly willing to have, and indeed asked, the Circuit Court of Appeals for the Fourth Circuit to adopt the construction of this Claim 2 that was put upon it by the Circuit Court of Appeals for the Second Circuit. (Judge Lacombe's opinion.) We quote from the stenographic report of the oral argument of Mr. Hector T. Fenton, counsel for the Boyden Company, addressed to the Circuit Court of Appeals of the Fourth Circuit, as follows:

"Before discussing the law applicable to functional claims, I shall precede that by a reference to that part of Judge Lacombe's decision in which he discusses this second claim, to see how he treats

its peculiar language, and what mechanism, if any, he reads into it by implication, to make it a claim for a mechanism and not a claim for a mere function. *If your Honors will now apply to this same patent and to this same claim No. 2 precisely the same construction and interpretation that Judge Lacombe gave to it in that case, we shall be perfectly satisfied."*

Surely a "variance" cannot be material to the issue of infringement where counsel for the defendant, the Boyden Company, is willing for the Court to adopt either view!

Now, since it has been decided that as matter of fact the Boyden Company's device did *not* contain an auxiliary valve it was perfectly immaterial for them and to the decision of the case, whether Claim 2 was declared invalid, as the petitioners contend was done by Circuit Court of Appeals for the Fourth Circuit, or valid where an "*auxiliary valve*" is included, as defined by the Circuit Court of Appeals for the Second Circuit. **In either case the decision must be for the defendant.** And yet the petitioners seriously press this alleged "variance" as a ground for invoking the extraordinary and unusual jurisdiction of the Supreme Court of the United States.

In truth, the attempt of the petitioners is simply to get before the Supreme Court by this transparent device, so as to have this Court put on Claim 2 a broad, general construction, to aid them in their future litigation. This Court does not, however, decide *moot* cases, and would not decide on any proposition which does not substantially affect the rights of the parties to the controversy. *Bartemeyer vs. State of Iowa*, 18 Wall., 129.

To show more fully that there is no variance, it must be added that these cases from the Second Circuit were pressed upon the Court for the Fourth Circuit, but that Court decided that this case did not involve the same question.

On this very point at the last part of the opinion the Court for the Fourth Circuit says:

"Here it is contended that the mere use of the extreme traverse of the triple-valve piston to effect the same *functional* result, which was effected by Westinghouse in 360,070 constitutes an infringement, irrespective of the additional means employed. There it was ruled that the use of the extreme traverse *and* of an additional machine the auxiliary valve attached to the original 220,556, which was structurally and *mechanically* equivalent to 360,070 was an infringement of the letters patent. The cases are different and not on all fours with each other, and do not control or affect our own ruling."

As to the other cases in the Second Circuit, e. g., 59 Fed. Rep., 581, and 63 Fed. Rep., 962, *the Patent 360,070 was not in suit*. It is incidentally referred to in construing the subsequent patents of Westinghouse, which were in litigation. In these cases no construction is given to Claim 2 of this patent, nor is any construction given to any of the other claims at all at variance with the rulings of the Court in the Fourth Circuit.

The petitioners, in their brief, do not give the Court the real reason why the device of one defendant, in the Second Circuit, was adjudged to infringe, while the device of the other defendant, in the Fourth Circuit, was held not to infringe.

This result was not due to any conflict or contrariety of decision between the two Courts as to the proper interpretation of the claim, but was due solely to the fact *that the respective devices of the two defendants were totally different from each other*. The Boyden Brake Co.'s device does not contain the invention of the second or any other claim of the Westinghouse patent, as the said claims were defined by either the Court of Appeals of the Second or the Fourth

Circuit, as it does not contain an *auxiliary valve device*. This may be seen at a glance by looking at the illustrations at the end of this brief, in which the *auxiliary valve device* is colored *red* wherever it appears.

The device of the New York Air Brake Co., the Defendant in the Second Circuit, *did contain* the invention as so *defined in all the claims*, as it did have an auxiliary valve device. This may be seen at a glance by examining the illustration of this device, the auxiliary valve device being colored red. (See the cuts at end of brief.)

Hence, the alleged variance is *not* a conflict of decision as to a question of law or the construction of the claim, but a difference of finding of fact on the issue of infringement. In the Second Circuit the Westinghouse invention was compared with a device substantially identical with it, while in the Fourth Circuit it was compared with a device which was totally different from it.

This is not a case of the Circuit Court of Appeals for one circuit rendering a different judgment from that of the Circuit Court of another, *under the same conditions*, which is the test of a variance fixed by this Court.

Columbus Watch Co. vs. Robbins, 148 U. S., 270.

Besides all this, an attentive reading of the whole opinion of the Circuit Court of Appeals for the Fourth Circuit will show that it did not *adjudicate* that Claim 2 was invalid, but only that if *literally* construed it would be "fatally defective" as claiming only a result without specifying the means for attaining that result. This was said in answer to the general and extended construction put upon these literal terms by the lower Court.

In another part of the opinion, however, Judge Hughes is careful to state, speaking of all the claims:

"The phrase substantially set forth" is technical and is equivalent to saying, "by the means

described in the text of the inventor's application for letters patent, as illustrated by the drawings, diagrams and models which accompany the application. These words limit the general terms of the specification which set out the *function* performed by the invention and confine the inventor's rights to his own *means* or their mechanical equivalent of performing the function."

Therefore, the last vestige of this allegation even of a formal variance disappears.

The petitioners state in their brief:

"And the urgency of the case becomes the stronger in view of the fact stated in the "thirteenth" paragraph (p. 5) of the petition herein, that there are other causes involving this claim, unheard and undecided, and more particularly one in the Eastern District of Missouri."

Brief pp 8 and 9.

This statement of "urgency" is conclusive of the weakness of the petitioner's case, for it is perfectly manifest that in the pending Missouri case, if the defendant there has an "auxiliary valve device," he will be enjoined; if he has *no* "auxiliary valve device," the bill will be dismissed; and these results will be reached equally by the citation of the decision in the Fourth Circuit or that of the Second Circuit.

(C.) SECOND ASSIGNMENT OF ERROR.

The second assignment of error is discussed by the petitioners in their brief, pp. 10-14.

The error alleged is that the Circuit Court of Appeals for the Fourth Circuit decided that claim 2 of patent 360,970 was "fatally defective," whereas the decision of the Court for the Second Circuit was manifestly correct.

Brief, p. 10, p. 12.

Without further arguing the matter we simply suggest the following conclusive answers to this assignment:

1. The Circuit Court for the Fourth Circuit did not so adjudicate.

2. Even if they did so adjudicate and such decision is error, the errors would not be ground for reversal, for by such alleged error the complainants could not have been prejudiced, as we have already fully argued. The petitioners concede that the decision in the Second Circuit is right, (brief-6-12) and we have shown that there is no material difference between this decision and that rendered in the Fourth Circuit, so far as the Complainants rights against these Defendants are concerned.

Lancaster vs. Collins, 115 U. S. 222.

3. *A fortiori*, this error, even if it exists, would not, in the absence of the *right* of appeal be any ground for certiorari.

This question is fully discussed in the first part of this brief. We call the Court's attention in passing to the inconsistency of the petitioner's own argument. On page 12 of the brief the petitioners concede that the decision of the Court in the Second Circuit was correct. That Court declared claim 2 of 360,970 to be valid, by reading into its general terms "*an auxiliary valve*." And yet on page 11 of this brief the petitioners endeavor to read into this claim 2, not "*an auxiliary valve*" as did the Court for the Second Circuit, but a "*suitable valve*," which is directly at variance with the decision in the Second Circuit.

It is interesting to note in this connection that the patent office "File Wrapper" of the patent in suit contains an explanatory letter written by the Attorney when asking for the allowance of claim 2, after it had been rejected by the official Examiner of the Patent Office. In this letter urging that the claim be allowed the Attorney interprets the meaning of claim 2 as follows:

"When, however, the triple-valve is provided with an '*auxiliary valve*' operated by its piston, which performs a new function additional to that of the triple-valve as previously employed, it is believed that *such* combination is wholly novel."

Record, p. 1175, top of page.

(D) THIRD ASSIGNMENT OF ERROR.

This assignment is discussed in petitioner's brief from page 14 to page 22.

In substance, the alleged error consists in this—that the Court in considering the fact that the Patent Office, after full examination, awarded a patent to Boyden on August 16, 1892, decided "that action by the Patent Office was, in effect, a ruling that the Boyden device did not infringe patent 360,070," and takes rank as the testimony of experts of the highest experience, skill and knowledge of mechanics.

Without following the Complainants through the long argument by which they endeavor to show that this ruling was erroneous, we suggest the following answers to this assignment:

1. The petitioners seem to forget that they are discussing a case of application for Certiorari, and argue the matter as if they were before this Court on appeal as a matter of right. Even if we should concede that this alleged ruling of the Court was an error, which we do not, it would not furnish any *ground* for Certiorari, as we have fully argued in the first part of this brief.

2. Suppose the petitioners were before this Court on appeal *as of right*, this alleged error would not be even a ground for reversal. It forms simply a part of the *reasoning* of the Court of a corroborative character, and the *reasonings* of a Court are no part of its rulings and are not the subject of appeal.

Bell vs. State, 57 Maryland, 116.

The ruling of the Court for the Fourth Circuit on this question is found in the following language of its decision:

"Comparing the two devices apart from the triple-valve piston in extreme traverse, we are unable to entertain a doubt that the ruling of the Patent Office was correct to the effect that Boyden's device was *not the mechanical equivalent* of that of Westinghouse. They seem to us to differ as widely from each other as two devices for accomplishing the same result can well differ."

The Court will observe that this ruling that Boyden's device was *not* the mechanical equivalent of the device of Westinghouse is reached by the Circuit Court of Appeals from a *comparison* of the two devices. That is their conclusion from the comparison. The ruling of the Patent Office is referred to simply as corroborating their opinion. It is evident that such would have been their opinion entirely independent of what the Patent Office did. Whether their reference, *arguendo*, to the effect of the Patent Office ruling, in this case, be right or wrong, the question, so far as the rights of the Complainants and the Defendants are concerned, becomes a mere *abstract* question. It may be important to decide these abstract questions of practice, in the workings of the Patent Office; but they cannot be made the ground for an appeal, and a *fortiori* not a ground for *certiorari* in an actual litigation, when the rights of the parties are not essentially involved in the proper decision of the question.

3. But the decision of the Court was right, though its language might have been a little more explicit. Ordinarily, in a proceeding for infringement, a later patent issued to the Defendant for the machine in question, is not admissible in evidence, on the ground that it is irrelevant to the issue made up in the pleadings, which is merely that of the validity of the patent in suit, and the similarity or dissimilarity of the Defendants' machine with that of the patent alleged to have been infringed thereby. The reason

is that a posterior patent could not justify an infringement of a prior one for the *same machine*. In this case the later patent and the ruling of the Patent Office were simply set up as corroboratory evidence that the Defendants' device, described and claimed in it, "*differs essentially*" quoad the part or improvement claimed in the prior patent from the machine of such prior patent. The Boyden patents and the quasi judicial finding of the Patent Office were used in corroboration to show that the device described and claimed in the later patents to the Defendants is *not the mechanical equivalent* for, or an improvement on, the device described and claimed in the earlier patent of Complainants, and that the devices of the two patents are distinct and different inventions, constructed and operating on different principles, though producing the same result.

This is the only use made by the Court of the Patent Office ruling, and in making this use of it the Court was undoubtedly right.

Miller vs. Eagle Co., 151 U. S., 186.

Corning vs. Burden, 15 How., 252.

Robinson on Patents, vol. 3, s. 1016:

(E) FOURTH AND FIFTH ASSIGNMENT.

These assignments require no special argument, as the reasons urged in this brief against the prior assignments apply with equal force to these assignments.

The Defendants, having fully answered all the various assignments and reasons given by the petitioners for the writ of Certiorari, respectfully insist that the petition should be dismissed, with costs and the application for the writ denied.

EDGAR H. GANS,

LYSANDER HILL,

Of Counsel for the Boyden Brake Co.

No. 403 and 426

OCT 22 1896

Supreme Court of the United States.
Brief of Hill for Boyden Co.
Decided Term, 1896. Nos. 403 and 426.
Filed Oct. 22, 1896.

BOYDEN POWER BRAKE COMPANY.

GEORGE A. BOYDEN, President.
CHARLES B. MANN, Secretary.
WILLIAM WHITRIDGE, Treasurer.

AND

BOYDEN BRAKE COMPANY.

Appellants.

APPEAL.

VS.

GEORGE WESTINGHOUSE, JR.

AND

THE WESTINGHOUSE AIR-BRAKE CO.

Appellees.

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CROSS-APPEAL.

**BRIEF OF ARGUMENT, FOR
BOYDEN BRAKE CO.**

LYSANDER HILL,

Of Counsel for the Boyden Brake Co.

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Supreme Court of the United States.

October Term, 1896. ⁴⁰³ Nos. 847 and ⁴²⁶ 878.

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CROSS-APPEAL.

BRIEF FOR DEFENDANTS.

STATEMENT OF THE CASE.

This suit, for an injunction and account, was commenced December 12, 1889, in the Circuit Court for the District of Maryland, by George Westinghouse, Jr., and the Westinghouse Air-Brake Company, Complainants, against the Boyden Power Brake Company, George A. Boyden, President, Charles B. Mann, Secretary, William Whitridge, Treasurer, and the Boyden Brake Company, (the original company having been reorganized under

the latter name), Defendants, charging the Defendants with infringing the *first*, *second* and *fourth* claims of the patent issued to George Westinghouse, Jr., March 29, 1887, No. 360,070, for Improvements in Fluid-Pressure Automatic Brake Mechanism. Several years were spent in getting the case ready for trial, and finally it was argued before his Honor Judge Morris, at Baltimore, in November, 1894, and decided by him March 11, 1895 (66 Fed. Rep., 997.)

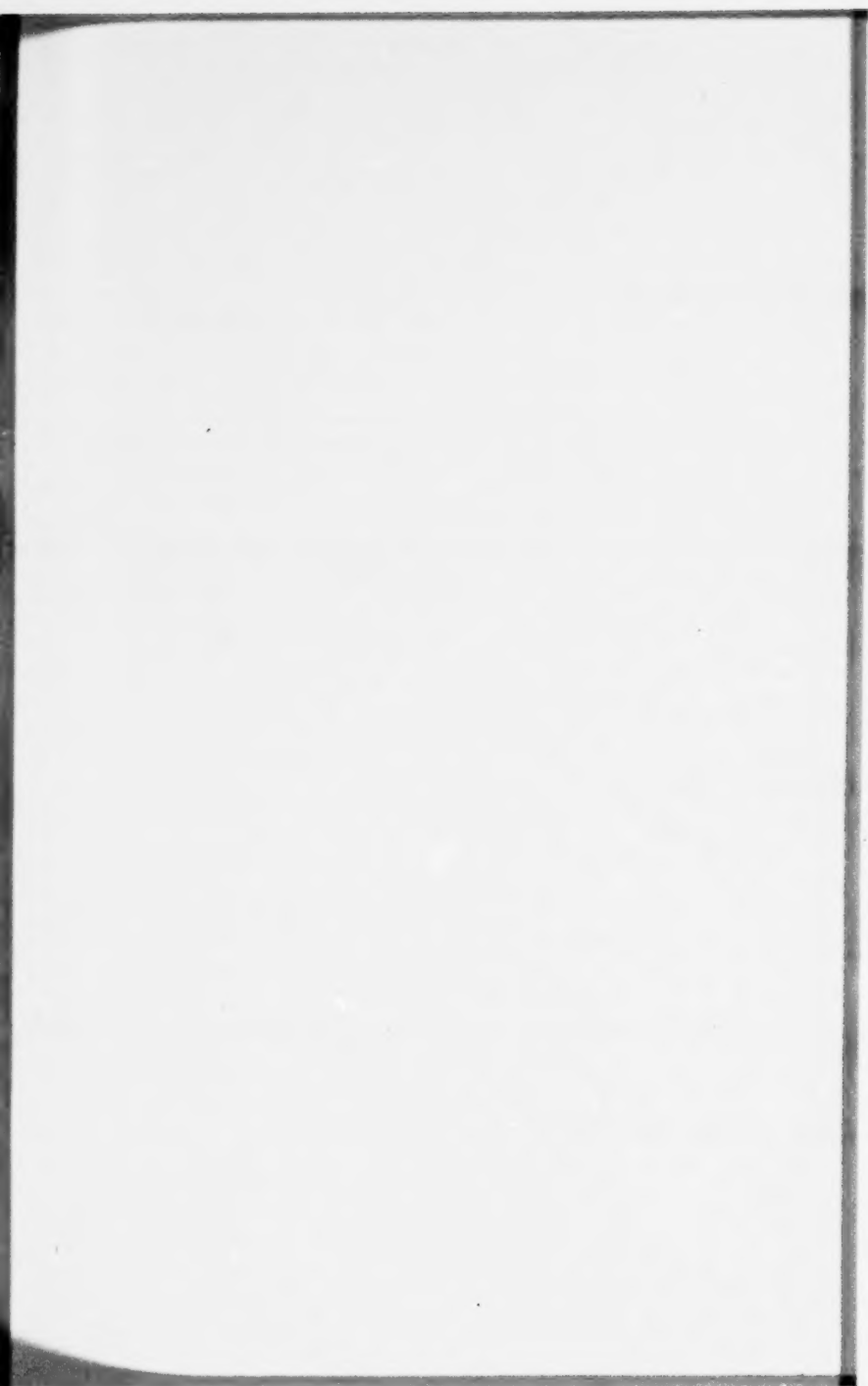
Judge Morris held, in substance, that the Boyden brake, the alleged infringing device, does not employ the "auxiliary" or "emergency" valve of the Westinghouse patent or any mechanical equivalent thereof, and, therefore, does not infringe the *first* and *fourth* claims, in which that element is expressly mentioned; but that the *second* claim of said patent, which is silent as to that element, is entitled to cover *functional equivalents*, or, in other words, *results*, and, in that view of the case that this claim was infringed.

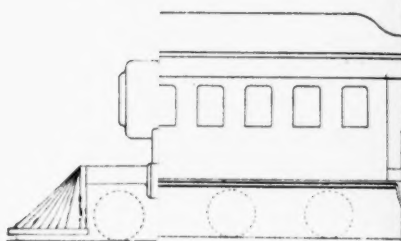
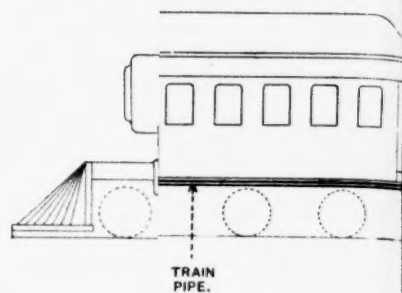
The Defendants appealed from so much of the decree as held them to have infringed the *second* claim; and the Complainants appealed from so much of the decree as held that the Defendants had not infringed the *first* and *fourth* claims.

On November 11, 1895, the United States Circuit Court of Appeals for the Fourth Circuit, sitting at Richmond, Va., rendered a decision (17 C. C. A., 430) affirming Judge Morris' decision on the *first* and *fourth* claims, but reversing it on the *second* claim, and directed the bill of complaint to be dismissed, which was done in obedience to its mandate. The Complainants then applied to this Court for a writ of *certiorari*, which was issued on January 30, 1896. Subsequently, on the petition of the Defendants, the case was advanced.

The only question to be determined is the question of infringement.

The invention in controversy consists in *mechanical means for producing a certain result which, in the air-brake art, is technically called "quick action."* The subject-matter of the patent in suit is comparatively simple, provided an intelligent understanding be first acquired of the air-brake mechanism as it existed prior to the date of said patent, March 29, 1887. We therefore, at this point, give a brief explanation of the development of the air-brake.





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STATE OF THE ART.

DIRECT OR STRAIGHT AIR-BRAKES.

(See illustration.)

In the early forms of air-brakes the locomotive was provided with an air-pump, a reservoir, an engineer's brake-valve and pipe connections, and the cars were each provided with a pipe extending lengthwise (commonly called the "train-pipe,") which at each end of the car has flexible hose and couplings, and a brake-cylinder containing a piston and rod. The operation of the above elements was as follows:

The air-pump compressed the air, which was stored in the reservoir ready for use, the engineer's brake valve preventing it from passing to the train-pipe and brake-cylinder on the cars.

To apply the brakes the handle of the engineer's brake-valve was turned to permit the stored air in the reservoir to pass to the train-pipe and direct to the brake-cylinders on the cars, and exert its force on the pistons therein, which in turn transmit the power to the brake-shoes and press them against the wheels by suitable intervening levers and rods, and thereby apply the brakes.

To release the brakes the handle of the engineer's brake-valve was shifted to its former position, permitting the air in train-pipe and brake-cylinders to be discharged to the atmosphere, thus releasing the brake-shoes from the wheels.

The "straight air" brakes were seriously defective in practical operation, because, if the train-pipe or connecting hose became ruptured, or uncoupled, the brakes could not be applied, for the reason that, under these conditions, when compressed air from the reservoir was admitted to the train-pipe the said air would escape to the atmosphere, and would not therefore operate the brakes, or, if the brakes were already applied, they would instantly be released when such rupture occurred.

AUTOMATIC AIR-BRAKES.

(See illustration.)

To remedy the inherent defect referred to of the "straight air-brakes," a new system known as the "automatic air-brake" superseded the "straight air." In the automatic air-brake system the locomotive is provided with the same devices as

were used with the "straight air-brake," and in addition each car is provided with a storage reservoir (called the "auxiliary reservoir," because it is auxiliary or additional to the main reservoir on the locomotive) and with a *valve device* termed a "triple valve," arranged at the juncture of the train-pipe, the auxiliary-reservoir and brake-cylinder, its functions being to transmit the air-pressure to and from the above devices in applying and releasing the brakes.

The essential elements of an automatic air-brake are :

- | | | |
|---|---|--|
| 1. Air-pump, | } | These made up the
"straight" air-brake. |
| 2. <i>Main</i> reservoir on locomotive, | | |
| 3. Engineer's brake-valve, | | |
| 4. Train-pipe, | | |
| 5. Brake-cylinder, | } | These were added to
make the "automatic." |
| 6. Auxiliary-reservoir on car, | | |
| 7. Triple valve. | | |

The Mode of Operating the engineer's brake-valve to apply and release the automatic brakes is the reverse of that employed with the "straight air-brake," that is to say, when the "automatic brakes" are to be released, the engineer's brake-valve admits air to the train-pipe, which passes to and effects the triple-valve on the car so that the air from the train-pipe passes into the auxiliary-reservoir, and at the same time discharges the air in the brake-cylinder to the atmosphere to release the brakes, and when they are to be applied said brake-valve discharges the air from the train-pipe, which again effects the triple-valve, so that the air stored in the auxiliary-reservoir passes to the brake-cylinder.

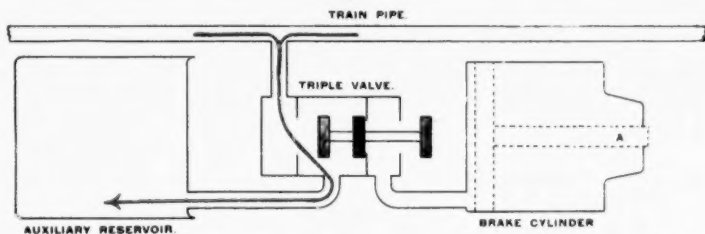
By the Invention of the "Automatic" the serious objection of the straight air-brake was overcome, because, if the train-pipe of the automatic should rupture, or the hose-coupling become disconnected, and thus accidentally allow the air therein to escape, the compressed air in the auxiliary-reservoir would at once be *automatically* admitted to the brake-cylinder and apply the brakes in the same manner as though the air were intentionally discharged at the engineer's brake-valve—hence the term "automatic" was applied to this form of air-brake.

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Simple Form of Triple Valve.

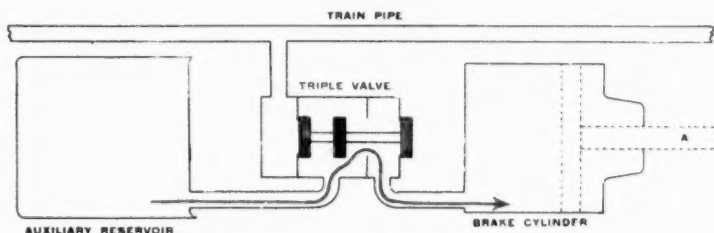
The diagrams below show the Train Pipe, the Auxiliary Reservoir, the Brake Cylinder and the Triple Valve of the "Automatic Brake" in a *simple* form in order to graphically define the philosophy involved.

Fig. 1.



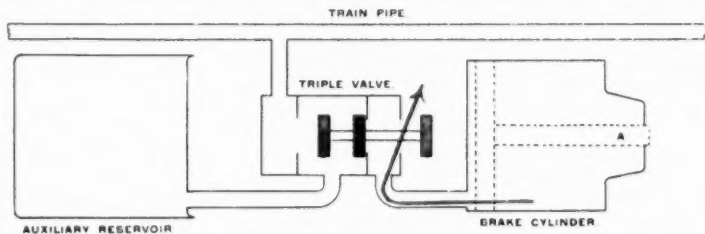
This cut shows the Triple Valve in the position to charge the Auxiliary Reservoir ready for use. The course of the air from the train pipe to the auxiliary reservoir is shown by the red line passing through the port of the feeding-in valve colored blue.

Fig. 2.



This cut shows the Triple Valve in the position to apply the brakes. The course of the air from the auxiliary reservoir to the brake cylinder is shown by the red line passing through the port of the main valve in solid black.

Fig. 3.



This cut shows the Triple Valve in the position to release the brakes. The course of the air from the brake cylinder to the atmosphere is shown by the red line passing through the port uncovered by the release valve colored green.

PHILOSOPHY OF THE TRIPLE-VALVE.

The functions of the triple-valve are, first, to charge the auxiliary-reservoir with compressed air from the train-pipe, and thus put the brakes in condition for use; second, to admit auxiliary-reservoir air to the brake-cylinder when it is desired to apply the brakes; and third, to discharge the compressed air from the brake-cylinder to the atmosphere when it is desired to release the brakes.

On the opposite page are inserted diagrams showing the train-pipe, auxiliary-reservoir, brake-cylinder and the triple-valve in a *simple* form in order to graphically define the philosophy involved, which is as follows:

To charge the brakes with air ready for use, the air from the train-pipe passes through the feeding-in-valve (colored *blue*) and thence to the auxiliary-reservoir where it is stored ready for use. The course of the air is shown by red line, Fig. 1.

To apply the brakes, the air is discharged from the train-pipe, and the expansion of air in the auxiliary-reservoir, causes the feeding-in-valve (colored *blue*) to close, and the main-valve (colored *solid black*) to open, which permits the air stored in the auxiliary-reservoir to pass through the main valve port to the brake-cylinder, and force out the piston rod, *A*, and thereby apply the brakes. The course of the air is shown by red line, Fig. 2.

To release the brakes, the air is again admitted from the train-pipe which causes the release-valve (colored *green*) to open and discharge the air from the brake-cylinder to the atmosphere, thereby releasing the brakes. The course of the air is shown by the red line, Fig. 3.

It will be seen that there are three functions involved in the operation of the triple-valve, hence the term "triple-valve," as used in connection with the automatic air-brake.

TRIPLE-VALVE OF PATENT 220,556.

"The triple-valve," as exemplified in the Westinghouse patent No. 220,556, October 14, 1879, and, in that form extensively used since, should be thoroughly understood before entering upon a discussion of the matters in controversy in the present suit.

The casing of the triple-valve (see cuts opposite the following page) is provided with a connection to the train-pipe, one to the auxiliary-reservoir and one to the brake-cylinder. The valves of this device are as follows:

First. The feeding-in valve, formed by part of the piston *G* (colored blue), whose *function* is to open a port *a* to admit compressed air from the train-pipe to charge the auxiliary-reservoir ready for use.

Second. The sensitive graduating-valve *e*¹ (colored yellow), whose *function* is to govern a port in the main valve *H* to admit auxiliary-reservoir air to the brake-cylinder in graduated amounts to partially or slowly apply the brakes.

Third. The release-valve *s* (colored green), whose *function* is to open a port to discharge the compressed air from the brake-cylinder to the atmosphere to release the brakes.

Fourth. The main valve *H* (colored solid black), whose *function* is to fully open a port *C* to admit auxiliary-reservoir air to the brake-cylinder quickly, in case it is desired to apply the brakes quick and stop the train *for an emergency*.

While four valves are embodied in this triple-valve 220,556, there are only three *functions*, because the *second* valve (yellow) and the *fourth* valve (black) perform the same *kind* of function, and differ only in the *degree* or manner of performance.

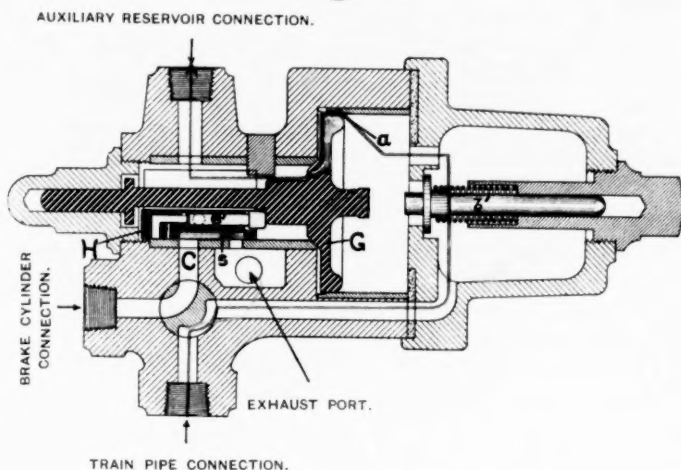
The piston *G* reciprocates in a cylinder, and *its function* is to *actuate* the several above-mentioned valves; the piston and its stem in the cut are etched with heavy lines to readily distinguish those parts from the casing, which are etched with lighter lines.

The operation of the "triple-valve" is as follows: To charge the brakes in readiness for use the engineer admits compressed air from the main reservoir on the locomotive to the train-pipe, the effect of which is to move the triple-valve piston *G* to the position shown in Fig. 1 (see cut opposite page), and thereby open the feeding-in-valve (*blue*). The air then passes from the train-pipe to the auxiliary-reservoir, its course being shown by the red line in Fig. 1. This reservoir is usually charged (as a maximum) with 70 pounds of air-pressure to the square inch.

To apply the brakes gently or by graduated application, in order to slack the speed of the train or to stop at a station, the engineer discharges a small amount of air from the train-pipe, which slightly lowers the pressure on the train-pipe side of the piston *G*, and the then higher pressure on the auxiliary-reservoir side causes the piston *G* to make its *preliminary traverse* which places it in the position shown in Fig. 2—against the abutting

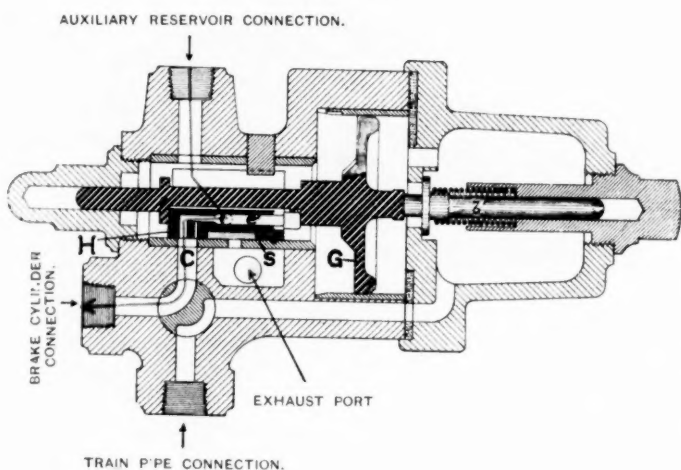
Triple Valve Device of Patent 220,556.

Fig. 1.



This cut shows the Valves and Piston **G** in the **Charging Position**, as used in 1. The course of the air in charging the Auxillary Reservoir is through the Port **a** shown by the Red line.

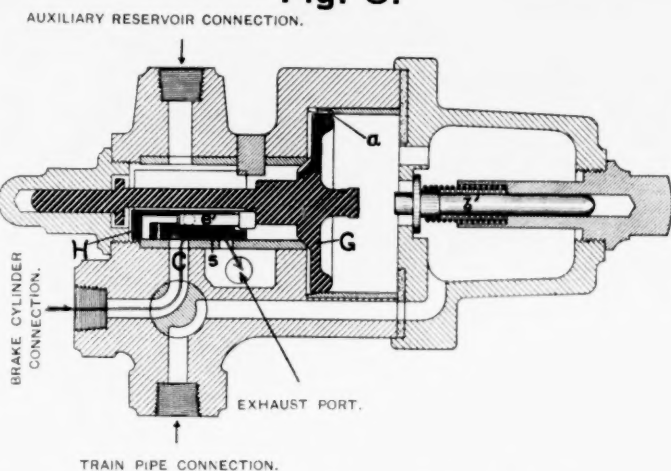
Fig. 2.



This cut shows the "**preliminary traverse**" of the Piston **G** and the Gradual Valve **a** and Main Valve **H** in position for graduating and service stops, as used in 1. The course of the air from the Auxiliary Reservoir to the Brake Cylinder is through

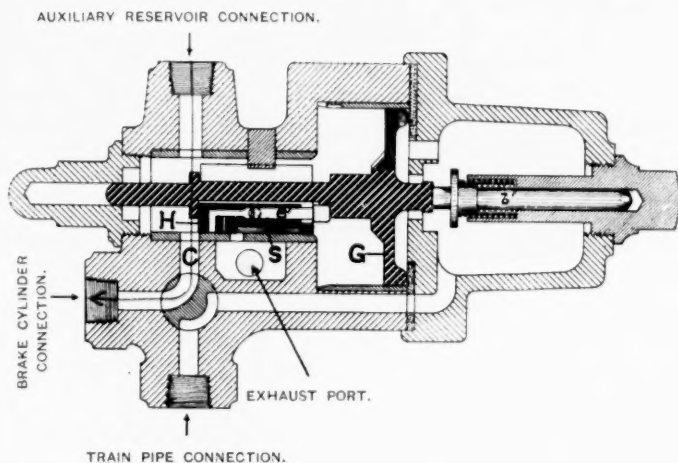
Triple Valve Device of Patent 220,556.

Fig. 3.



This cut shows the Valves and Piston **G** in the **Release Position**, as used in 1879. The course of the air is from the Brake Cylinder to the atmosphere through the Port **s**, shown by the Red line.

Fig. 4.



This cut shows the "**further traverse**" of the Piston **G** with the Main Valve **H** in position for an emergency stop. The Port **C** thereby being opened to its full capacity to admit air to the Brake Cylinder quickly, as used in 1879. The course of the air from the Auxiliary Reservoir to the Brake Cylinder is through the Port **C** opened by the Main Valve **H**, shown by the Red line.

stem b^1 , which arrests its movement. The function of this "preliminary traverse" of the piston is to close the release-valve (*green*) and open a port through the main valve H (*solid black*), which is governed by the sensitive graduating valve e^1 (*yellow*); this permits the auxiliary-reservoir air to pass to the brake-cylinder (the course of the air is shown by a red line, see Fig. 2), until the pressure in the auxiliary-reservoir is reduced below that existing in the train-pipe, the latter pressure, then preponderating, moves the piston back, which causes the graduating valve e^1 (*yellow*) to close the port through the main valve H (*solid black*), and thereby prevent any additional air from entering the brake-cylinder and holds the brakes partially applied. If an increase of braking pressure should be desired this graduating operation must be repeated.

To release the brakes the engineer re-establishes the maximum pressure (70 pounds) in the train-pipe, which moves the triple-valve piston G to the former position, and thereby opens the release-valve (*green*) so that the air will be discharged from the brake-cylinder to the atmosphere (the course of the air is shown by a red line in Fig. 3), and at the same time communication is established through the feeding-in-valve (*blue*) between the train-pipe and auxiliary-reservoir whereby the latter is recharged for future use. (See Fig. 1.)

To apply the brakes fully and as quickly as possible for an emergency in case of an accident, a greater amount of air is discharged by the engineer from the train-pipe than is required for merely partially applying or graduating the brakes. This *greater* reduction of pressure in the train-pipe causes the piston G of the triple-valve to make its full or *further traverse*, which forces the abutting stem b^1 to the right, as shown in Fig. 4. The function of this full or "*further traverse*" is to move the main-valve H (*solid black*) to fully open the port C to allow the auxiliary-reservoir air to quickly pass to the brake-cylinder and apply the brakes quickly (the course of the air being shown by a red line—Fig. 4) or in a briefer space of time than can be done through the graduating-valve e^1 (*yellow*) actuated by the *preliminary traverse* of the piston.

It is therefore seen that a "triple-valve," prior to the patent in suit, as exemplified in patent No. 220,556, dated October 14, 1879, consisted of four valves, namely, the feeding-in-valve (*blue*), the graduating-valve (*yellow*), the release-valve (*green*),

and the main-valve (*solid black*); and also it is seen that the said valves were actuated by a piston *G*, which had a preliminary traverse and a full or further traverse. It will also be noted that when *applying the brakes*, auxiliary-reservoir air may be admitted to the brake-cylinder by either one of two separate valves, to wit, the graduating-valve *e*¹, (*yellow*, see Fig. 2), for ordinary service work, or the main-valve *H* (*black*, see Fig. 4), for emergency work.

The form of triple-valve above described, and shown in the Westinghouse patent of October 14, 1879, No. 220,556, was the result of a series of improvements successively engrafted upon the original crude automatic air-brake patented by Mr. Westinghouse March 5, 1872, No. 124,404.

DEVELOPMENT OF THE TRIPLE-VALVE.

In his first improvement, patent August 12, 1873, No. 141,685 (p. 736), he invented the original form of triple-valve corresponding in principle to those which have since made the automatic air-brake successful and famous. In this original device, *the main valve*, which admits air from the auxiliary-reservoir to the brake-cylinder to apply the brakes, *was of the poppet form*, and, as a poppet-valve can govern only one port, separate valves had to be provided for feeding-in the air from the train-pipe to the auxiliary-reservoir, and for discharging the air from the brake-cylinder to release the brakes. The three separate valves constituting the triple-valve were actuated by a flexible diaphragm (the equivalent of a sliding piston.) The main valve was provided with a tapering plug, *a*, for graduating purposes, and was capable of admitting air rapidly or slowly from the auxiliary-reservoir to the brake-cylinder, according as the engineer caused the diaphragm (or piston) to be moved through its entire traverse or only through a portion of its traverse. This patent, therefore, contained the germ and principle of everything that is to be found in the later patent of October 14, 1879, No. 220,556.

In patent of October 28, 1873, No. 144,006 (p. 740), Mr. Westinghouse improved upon his prior devices by substituting a sliding piston for the flexible diaphragm, *by providing a check-valved air-passage through the piston for charging the auxiliary-reservoir*, and by making some changes in the form of the main

valve and the release valve, still, however, retaining *the poppet form of the main valve*.

May 11, 1875, C. H. Perkins, assignor to George Westinghouse, Jr., No. 163,242, and August 3, 1875, W. D. Jones, No. 166,386, (p. 745), and H. L. Perrine, No. 166,405 (p. 749), further improved the triple-valve by substituting a sliding piston-valve for the poppet form of main valve previously used by Mr. Westinghouse. This enabled a single sliding member to perform the feed-valve function of admitting air from the train-pipe to the auxiliary reservoir, the main-valve function of admitting air from the auxiliary-reservoir to the brake-cylinder to apply the brakes, and the release-valve function of discharging air from the brake-cylinder to release the brakes.

Mr. Westinghouse immediately saw the advantages of the slide-valve, and was quick to appropriate them to his own use by improving the form of its embodiment. He decided that a piston actuating a slide-valve was preferable to a piston-valve; and, October 5, 1875, took out an important patent, No. 168,359 (p. 752), covering this improvement. In the latter patent the piston itself (marked *G*), is made to operate as a feed-valve in connection with the small lateral passage *s*, while the main-valve function and release-valve function are lodged in a large slide-valve *H* held between two fixed collars on the piston stem and, therefore, moving with the piston. The piston is adapted to move through a portion of its traverse to partially open the main port *e* for graduating the brake-pressure, and through its entire traverse to fully open said port when necessary to apply the brakes with full pressure in the shortest possible time. The release of the brakes was effected through a recess in the face of the main-valve *H*, which, when the apparatus was in normal running position, connected the exhaust port, *e'* with the passage leading to the brake-cylinder. In the first part of its stroke to apply the brakes, the piston moved without opposition; but to complete its full traverse it had to overcome the resistance of a spring-controlled stem *d'*; provided, as the patent states, "in order to render this operation of graduating the air-pressure in the brake cylinders more easy and certain," that is to say, in order to enable the end of the main-valve *H* with greater certainty to partially uncover the port *e* for graduating purposes, and to wholly uncover said port when sudden danger

or "emergency" required the quickest and strongest possible application of the brakes.

In patent of January 11, 1876, No. 172,064 (p. 752), Mr. Westinghouse reverted to the type of feed-port first found in his patent of October 28, 1873, No. 144,006 (p. 740), namely, by a passage *through* the triple-valve piston. He contrived a small stem or needle-valve, *c*, to govern said feed-port, and, by making the main-valve a little shorter than the distance between the two collars which actuate it, he gave the piston a slight degree of "lost motion" with respect to the main-valve, thereby enabling the needle-valve to close the feed-port without disturbing the main-valve.

Three years experience with the triple-valve as thus far perfected demonstrated that, while it was of great utility and value, it was not sufficiently *sensitive* to graduate as perfectly as was desirable. The reason of this was, that the large exhaust recess in the face of the main-valve caused the air-pressure behind the latter to press it strongly against its seat (see testy. of H. H. Westinghouse, p. 324, Ans. 550), so that considerable force was required to slide it, and that, after the brakes were set by graduation, if a force was applied sufficient to overcome the friction and slide the valve back far enough to close the passage to the brake-cylinder, in order to hold them set, it was liable to slide it clear to the inner end of its traverse, open the release-port, and thus accidentally release the brakes instead of holding them set. Mr. Westinghouse set himself at work to remedy this defect, and the result of his efforts appears in patent No. 220,556, dated October 14, 1879 (p. 762).

In this patent, he retained the "lost motion" of patent No. 172,064, and used it to operate a small sensitive graduating-valve *e*¹, working in a passage formed in the main-valve *H*, so that in graduating, the piston could cause the sensitive valve to open and close its port without disturbing the main-valve. This *sensitive graduating-valve* substantially perfected the Triple-Valve for ordinary passenger service, and has been used in one form or another, on all air-brakes since 1879. A complete description of its operation has already been given in this Brief on pp. 5, 6, 7 and 8.

TWO TRAVERSES OF THE PISTON—OLD.

In all the triple-valves above mentioned, the piston (or

diaphragm) was capable of a "preliminary" or partial traverse, for graduating purposes, and a "further" or complete traverse, for emergency purposes. By its partial traverse, the triple-valve partially opened the passage from the auxiliary-reservoir to the brake-cylinder and applied the brakes slowly; by its complete traverse, it opened said passage to its full capacity and applied them quickly with full force. The specification of patent No. 220,556 (p. 764, near the bottom) refers to the use of the partial traverse for graduating purposes, saying: "When now the valve *H* is thus shifted, so that the port *s*¹ shall, to the extent of one-quarter or one-half its capacity, more or less, *as is usual when less than a maximum breaking force is desired*, be thus brought into communication with the port *C*," etc., etc. The specification of patent 168,359 (p. 754, near the bottom) refers to the same subject in these words: "Hence the piston *G* may be brought down so that while entirely closing the supply-port *s* it shall bring the valve *H* to a position where it shall uncover only a small part of the port *e*, *or any desired part*." The specification of the original triple-valve patent No. 141,685 (August 12, 1873), indicated this operation as follows (p. 738, near the middle.):

"The area of the opening through the port *o*¹ is regulated *by the distance which the plug *o* is caused to move vertically upward*. * * * By the use of the "taper plug *o*, in the manner described, and by regulating, as can easily be done by the use of suitable cocks, "the amount of pressure in the upper and lower parts of "chamber *G*¹, it is easy to regulate the amount or density "of the air which is permitted to flow through the port "o¹ into the brake-cylinder, and consequently easy to "regulate and adjust, at all times, the force with which "the brakes are applied, *and such force may be varied "from the maximum power of the brakes down to the "fractional part of a pound in excess of ordinary "atmospheric pressure*."

Mr. H. H. Westinghouse, testifying as to the triple-valves in use prior to 1886, said (p. 123, near bottom):

“And all the operations of supplying the auxiliary reservoir, admitting air to the brake-cylinder of limited pressure, and of discharging the air from the brake-cylinder for the purpose of release, are performed by a *partial* movement of the piston and valve mechanism of the triple valves. It is only for ‘emergency’ operations or quick stops that the *final and complete* movement of this piston and valve is required. This final movement is obtained by a rapid and considerable reduction of pressure in the train-pipe, as compared with what is required for ‘service operations.’”

In the statement of facts preceding its opinion in this case, the Circuit Court of Appeals said:

“In the Westinghouse automatic air-brake, as patented in No. 220,556, the ordinary work of braking was performed by a partial traverse of its chamber by the triple-valve piston, graduated, according to the purpose desired, at the will of the engineer; and emergency work was done by an extreme traverse of the piston to the end of its chamber. It may be observed that the automatic air-brake, patented as No. 220,556, which embraced all previous improvements, is now free to public use, the patent having expired and ceased to be confined to the exclusive use of its inventor.”

TRIPLE-VALVE DEFECTIVE ON LONG TRAINS.

The triple-valve, thus slowly evolved from the original form of patent No. 141,685, August 12, 1873, to the highly improved form of patent No. 220,556, October 14, 1879, and in the latter form used by the complainants without further material improvement till the year 1888, was satisfactory for short trains consisting of eight or ten cars or less, but on long trains consisting of forty or fifty cars or more, it was not only unsatisfactory, but absolutely impracticable; *and its impracticability resulted from the very fact that the piston had the two traverses* referred to by Mr. H. H. Westinghouse at the bottom of p. 123, namely, a partial traverse for graduating purposes, and a full traverse for emergency stops.

The defective operation of the brakes occurred *only when making emergency stops*—their operation in graduating being entirely satisfactory. The cause of the trouble was as follows :

In making an emergency stop, the engineer throws his controlling valve wide open, allowing the air to escape from the train-pipe at the engine with the utmost possible speed. A great reduction of air-pressure instantly takes place in the forward end of the train-pipe, and travels back like a wave towards the rear end of the train. As it reaches the triple-valve of the first car, it causes the piston and main valve to be forced through their entire traverse, thereby suddenly opening to its full capacity the port or passage leading from the auxiliary-reservoir to the brake-cylinder and almost instantly applying the brakes with full force. The result is, that the first car is suddenly checked in its speed before the wave of train-pipe pressure reduction has had time to reach the second car and set brakes thereon ; and the second car runs forward at full speed and bumps against the first car, whose speed has already been checked. The same thing takes place between the second car and the third, the third and the fourth, and so on throughout the train. In other words, the brakes would apply on the forward cars of the trains in an appreciable time before they applied on the rear cars, thus checking the forward end of the train to such an extent that the rear cars would run into them, causing serious results from the collision. (See testy. of H. B. Stone, p. 136, ans. 51.) The effect is about the same as striking a precipice. Oftentimes the rear cars have been completely demolished by such a collision.

In *graduating*, however, the train-pipe pressure is but slightly reduced ; the piston and main-valve execute only a partial traverse ; the port leading from the auxiliary-reservoir to the brake-cylinder is only partially and momentarily opened ; the air flows slowly in'to the brake-cylinder ; and before the brakes effectively check the first car they are already commencing to apply on the second car. Hence, no "shock" is produced, and the train quietly and smoothly reduces its speed or gradually comes to a full stop.

The Circuit Court of Appeals said (p. 879) :

"That machine, 220,556, was designed both for graduated braking and for emergency braking. The former

“was provided in the sensitive valve inserted in the stem
 “of the triple-valve piston, through which compressed
 “air was vented at the will of the engineer from the
 “auxiliary-reservoir into the brake-cylinder. But this
 “earlier and expired patent contained more than the
 “sensitive valve in the stem of the piston, and more
 “room in the piston chamber than was necessary for a
 “partial traverse of the piston. It contained a main
 “valve and a sufficient prolongation of the piston cham-
 “ber for the extreme traverse. This main-valve and this
 “prolongation of the chamber were entirely useless for
 “graduated work, and were intended and employable
 “only for emergency work.”

The triple-valve of patent 220,556 and its predecessors were, therefore, well adapted for short trains, but for long freight trains they were practically useless; and in air-brakes used on *freight trains*, Mr. Westinghouse was obliged to omit the emergency port and abandon the attempt to make quick emergency stops (see testy. of H. H. Westinghouse, p. 142, Ans. 133.) With the emergency port thus omitted, a large reduction of train-pipe pressure holds the graduating port open long enough to gradually charge the brake-cylinder with full pressure, but so slowly that the train, if moving swiftly, necessarily must run a considerable distance before stopping.

This was a serious defect in freight brakes. The power to make a quick emergency stop is of extreme importance to the safety of life and property. The question, therefore, arose: “How can both the graduating function and the emergency stop of patent 220,556 be retained and used, and yet the emergency stop be effected without producing fearful shock?” This was the problem to be solved.

INVENTION OF MEANS TO QUICKEN THE APPLICATION OF BRAKES.

It was known that the “shock” was occasioned by the interval between the sudden application of the brakes on successive cars, and that if this interval could be shortened so that the brakes would begin to set on the second car before they had checked the first car, there would be no shock. A French engineer had discovered and demonstrated that if all the

triple-valves along the train be operated simultaneously, by means of an electric current controlled by the engineer, no shock is produced even in the most sudden emergency stop. The use of electricity for the purpose was objectionable, and it became desirable, therefore, that other means should be discovered for reducing the intervals occurring in the serial application of the brakes. Mr. Westinghouse turned his attention to this subject as early as 1879, and then conceived the idea that if the engineer could vent the train-pipe not only at the locomotive but *also under each car*, the serial application of the brakes could be greatly quickened, because the train-pipe air would escape at the *nearest* opening, instead of traveling to the locomotive, and thus the reduction of train-pipe pressure from one end of the train to the other, would be greatly expedited. This idea he embodied in patent No. 217,838, dated July 22, 1879, wherein he set forth the principle in the following language :

"It sometimes happens with such brake apparatus, *especially in case of accident*, that material advance could be effected by having all the brakes of the train applied or brought into action *simultaneously, or as nearly so as possible*. To accomplish this it is only necessary to make provision for the *simultaneous opening of one or more ports in the air-conduit passages at points not remote from each auxiliary reservoir*. For this purpose I arrange at such various parts of the air-conduit or communicating pipes as may be desired, but by preference at the couplings, relief-valves of the kind shown in the drawings."

He did not put this invention into general use on the railroads ; but, during the taking of the evidence in this cause, the Defendants demonstrated by actual tests of 50 brakes that the apparatus of the 1879 patent accomplishes all that Mr. Westinghouse claimed for it, reducing the time of applying the brakes on the rear car from twelve seconds down to six.

June 26, 1883, George A. Boyden, one of the Defendants, took out a patent, No. 280,285, in which the triple-valve not only controlled the admission of air from the train-pipe to the auxiliary-reservoir and from the auxiliary-reservoir to the

brake-cylinder, but also contained a check-valved passage leading from the outer end of the triple-valve piston-chamber to the main-valve chamber, so that compressed air could be transmitted directly from the train-pipe to said valve-chamber, and thence to the brake-cylinder, to augment the pressure of the brakes.

Such was the state of the art at the date of the invention in controversy in 1886.

GENESIS OF THE WESTINGHOUSE QUICK-ACTION AIR-BRAKE.

In 1885 the Master Car Builders' Association, an organization composed of those having charge of the construction and maintenance of car equipment upon railroads in the United States and Canada, and also those engaged in the manufacture of cars for sale, appointed a committee to investigate the relative merits of several brakes that were represented by their owners as suitable for general use upon freight cars. (H. H. Westinghouse, p. 117, Ans. 47.) This led to a series of tests in July, 1886, in Burlington, Iowa, a second series of tests in May, 1887, at the same place; and a third test at the same place in the fall of 1887, followed by the exhibition of a train of cars by the Westinghouse Air-Brake Co. on various railroads in the United States during the same fall. A full history of the matter is given by Mr. H. H. Westinghouse, in his answer 47 (pp. 117-135), and by Mr. H. B. Stone, in his deposition (pp. 135-138). The history is briefly as follows:

The test of July, 1886, on trains composed of fifty cars, demonstrated that air-brakes *in which the valves are actuated by electricity* effect an emergency stop without "shock;" but that air-brakes of the type of patent No. 220,556, in which electricity was not employed, and in which it took an average of 12 seconds to apply the brakes on the rear car, produced destructive and dangerous shocks. The degree of shock was measured by an instrument called a slidometer, in which an indicator was, by the stopping of the train, caused to slide to a distance proportionate to the force of the shock. Shocks of 12 inches were sufficient to injure live stock and equipment; repeated shocks of from 12 to 20 inches were sufficient to start

the loads, at the rear end of the train, through the ends of the cars; a shock of 63 inches broke the train in two, and nine of the rear cars, although loaded with special care and the loads protected by timber, had their ends broken and bulged out, by the shifting of the loads, to such an extent that they were in a dangerous condition (p. 119). The committee reported in favor of the air-brake which had its valves actuated by electricity; but doubted the reliability of electricity for practical use, and recommended further investigation (pp. 126, 127). The result was, the second series of tests on 50-car trains, which commenced May 13, 1887.

The test of July, 1886, proved conclusively that the shocks, (which occurred only in emergency stops), were due solely to the fact that the interval of time was too long between the application of the brakes on the successive cars. After this test was over, Mr. Westinghouse set himself at work to see if he could shorten such interval without the aid of electricity. He reverted to the principle of providing an *additional* and special valve for the purpose of venting the train-pipe under each car to the atmosphere, as set forth in his patent of July 22, 1879, No. 217,838; but modified the embodiment there shown by providing that said valve should be operated by the piston of the triple-valve of patent No. 220,556 in the act of making its final or complete traverse for an emergency stop (p. 124). Subsequently, he further improved this quick-action device by providing that the *added special valve* should vent the air into a *check-valved by-passage* leading directly from the train-pipe to the brake-cylinder, so as to save and utilize the locally vented air instead of discharging it to the atmosphere. And, on March 29, 1887, he patented this improvement in the patent here in suit, No. 360,070.

THE DEVICE OF THE PATENT IN SUIT.

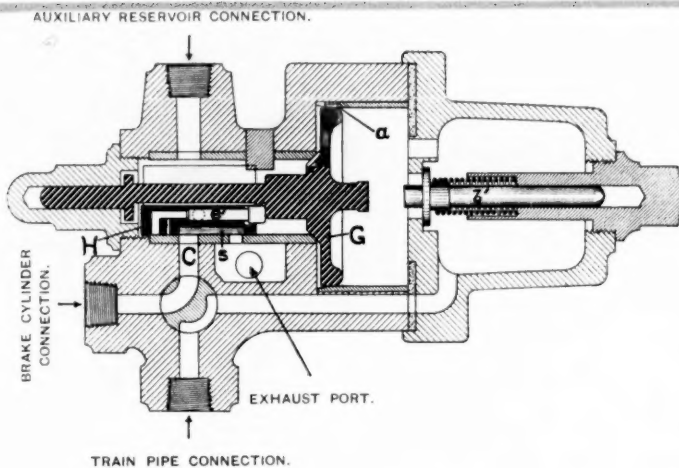
In this device Mr. Westinghouse took the old plain triple-valve of patent 220,556 as the foundation of the structure. The piston of that valve already had a *preliminary* or *partial* traverse for graduating purposes, and a *final* or *further* traverse for emergency stops. (See testy. of H. H. Westinghouse, p. 307, Ans. 488.)*

To this old structure, he *added* his new auxiliary-valve and its check-valved *by-passage*, and arranged them so that the new auxiliary-valve, designed only for emergency-stop purposes, should be brought into action by the *old further* or emergency traverse of the piston. The change thus made is clearly illustrated in the three cuts opposite this page, where the members added to the device of patent 220,556 to form the improved device of patent 360,070, are shown in *red*, the first of the three cuts representing the old triple-valve of patent 220,556, the second cut representing the entire new combination with the auxiliary-valve 41 seated and closing the by-passage 42, 43, 46, and the third cut representing the entire new combination with the auxiliary-valve 41 unseated, as in the act of making an emergency stop. The course of the air from the auxiliary-reservoir to the brake-cylinder, passing through the triple-valve, is shown by a yellow line, and the course of the air from the train-pipe, passing through the auxiliary-valve device to the brake-cylinder, is shown by a blue line. It will be noted that the course of the train-pipe air (blue) is wholly *independent* of the triple-valves. It is obvious at a glance that if the auxiliary-valve 41 were removed and the passage 42, 43, 46 plugged or closed, the structure of 360,070 would simply be reduced back to the old device of patent 220,556.

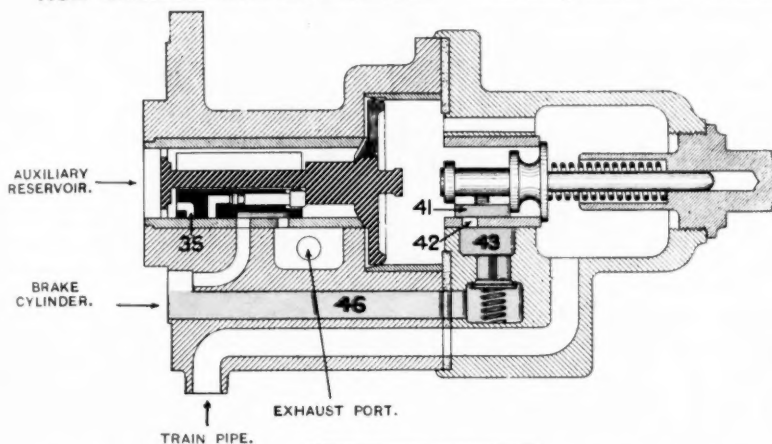
In graduating or making a service stop, the new structure operated precisely like the old—the piston, in such cases, not moving back far enough to unseat the auxiliary valve 41; but in making an emergency stop, the piston, executing its full

*“ In the construction, as shown in patent 220,556, the opening of the larger port from the auxiliary-reservoir to the brake cylinder under certain circumstances (emergency) requires that the traverse of the triple-valve piston and its valves shall be *considerably greater* than is required to make the less rapid (or graduated) application of the brakes, and this requirement of *further traverse* increases the length of all the principal portions of this structure fully twenty-five per cent.”

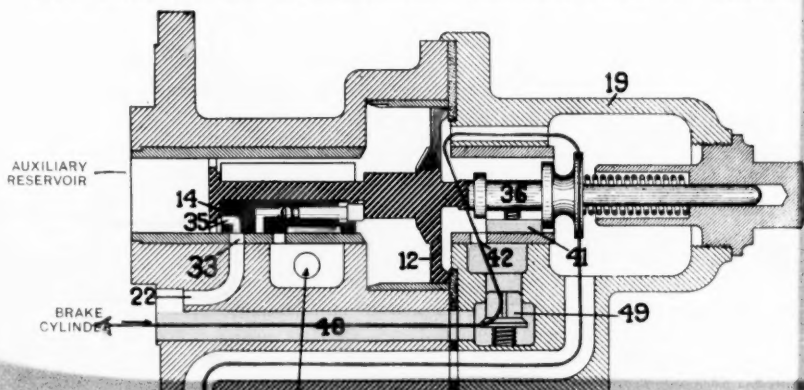
Testy. of H. H. WESTINGHOUSE, p. 307, Ans. 488.



New Structure with the Additional "Auxiliary Valve 41" Closed.



New Structure with the Additional "Auxiliary Valve 41" Opened.



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traverse, unseated the auxiliary valve and vented the train-pipe air directly through the by-passage into the brake-cylinder, thereby causing a more sudden reduction of pressure in the train-pipe than if said air had to travel to the locomotive, and hence, speeding the application of the brakes on the next succeeding car. To prevent the heavier pressure of the auxiliary-reservoir from entering the brake-cylinder too quickly, and by its back-pressure checking the vent from the train-pipe, Mr. Westinghouse restricted the main port of the main valve 14 by somewhat elongating the main valve and cutting a small port 35 through it to register with the passage 33 when making an emergency stop, instead of using a shorter main valve arranged to entirely uncover the passage C, as in patent 220,556.

In making an emergency stop with this apparatus, the unseating of the new auxiliary-valve 41 would suddenly vent from the train-pipe to brake-cylinder a pressure of about 25 pounds to the square inch (see specification of patent 360,070, p. 467, near bottom of page); and the air flowing from the auxiliary-reservoir to the brake-cylinder through the passage 35-33 (as at C in the old triple-valve, but somewhat more slowly by reason of the restricted main port 35) would then gradually raise the 25 pounds in the brake-cylinder to about 55 pounds.

THE NEW APPARATUS A PRACTICAL FAILURE.

With the apparatus of patent 360,070, which we have just described, Mr. Westinghouse appeared at the Master Car Builders' second Burlington test, commencing May 13, 1887, he having also appeared at the first test, in 1886, with a plain triple-valve; *but the apparatus of 360,070 was a complete failure, so far as concerns the prevention of shocks*, the sole object of its existence. It reduced the time of applying the brakes on the rear car to less than six seconds, but it did not shorten the time enough; and the result was, that *the shocks were increased instead of being diminished*, the slidometer showing a "shock" of 103 inches as compared with the maximum of 49 inches shown by the old automatic triple-valve at the first tests of July, 1886 (p. 126.)

"In fact," says *Mr. H. H. Westinghouse*, when testifying as to the shock produced by the device of patent in

suit (p. 126), "they were so severe that it was not *deemed*
 "prudent to use the brake in emergency applications
 "without the use of the electrical valves heretofore
 "described. When these were used, the desired coinci-
 "dence of operation was secured and stops were made
 "without perceptible shock."

The Committee reported (p. 128) that:

"The brilliancy of the record was completely spoiled
 "by the fearful shock given at the rear end," and that
 " * * * in the electrical stops, the slidometer never
 "moved, and this with the same cars, the same leverages,
 "and the same pressures, the only difference being the
 "time of application."

Mr. H. H. Westinghouse testifies (p. 130) that:

"The conclusion of the 1887 trials (with the device of
 "patent 360,070), instead of furnishing to the railroads
 "the desired information upon which to take prompt and
 "reasonable action, served to show that much yet
 "remained to be done before it could be safe to make a
 "practical move in a matter of so great importance.
 "These sentiments were clearly expressed in the com-
 "mittee's conclusion from the 1887 trials."

The problem was still unsolved; and immediately after the close of the tests at Burlington in May, 1887, Mr. Westinghouse again went to work to effect its solution, which result he finally accomplished in the fall of 1887, *six months after the failure of the device of the patent here in suit*, and by means of devices patented by him January 24, 1888, No. 376,837, which reduced the time of applying the brakes on the rear car down to two seconds.

THE SUCCESSFUL DEVICE OF PATENT No. 376,837.

(NOT HERE IN SUIT.)

After the failure of the device of patent No. 360,070, in the Spring of 1887, the invention of the successful device of patent 376,837 was by no means obvious or easy, but required intense study and great inventive ability. *Mr. H. H. Westinghouse* (p. 131) testifies as follows :

"In obtaining this maximum result" (that is, evolving the successful device of patent 376,837) "the period of time "from the middle of May, immediately after the completion of the 1887 trials, until the first of October was "consumed. As may be imagined, the final result was "not obtained at once, but by repeated steps which required the complete refitting of the 50-car train not less "than three times. All the resources and employes that "could be used were kept at work day and night without "cessation, and the materials for trial, each time involving more than a car-load, was conveyed from Pittsburg "to Burlington by express, so that no time might be lost. "When, finally, in the latter part of September, 1887, the "last brake was applied in two seconds from the time of "the movement of the valve by the engineer, the source "of objectionable criticism that had heretofore existed "against the use of compressed air, unaided by electricity, "in the operation of power brakes upon long freight "trains, disappeared, and the "quick-action automatic" "brake, *as then constructed and organized*" (see patent 376,837, not in suit), "became, and has since been, the "standard power-brake apparatus for both freight and "passenger trains."

It will conduce to a better understanding of the character and limitations of the invention of patent 360,070, if we now examine the apparatus of patent No. 376,837 and observe the difference between the two devices.

In 376,837, the auxiliary-valve 41 is no longer immediately adjoining the piston so as to be actuated directly by the impact of the triple-valve piston, as in 360,070, but in the second patent is arranged opposite the main-valve chamber and actuated by a *supplementary piston*, 63, which supplementary piston, in its turn, is actuated by auxiliary-reservoir air admitted against its inner end by the extreme movement of the main-valve 14, in the act of making an emergency stop. The device is represented in the cut on the opposite page, in which the "auxiliary valve" and by-passage, the *additional members* of patent 360,070, are shown *in red*, and the still further additional members of a "supplemental piston" and piston-chamber, of patent 376,837, are shown *in brown*. The triple-valve is the *same* as that of patent No. 220,556, with an extra port uncovered by the main-valve to admit air from the auxiliary-reservoir against the supplementary piston 63, which actuates the "auxiliary-valve."

It therefore clearly appears that the points which are common to both patents—360,070 and 376,837—are as follows:

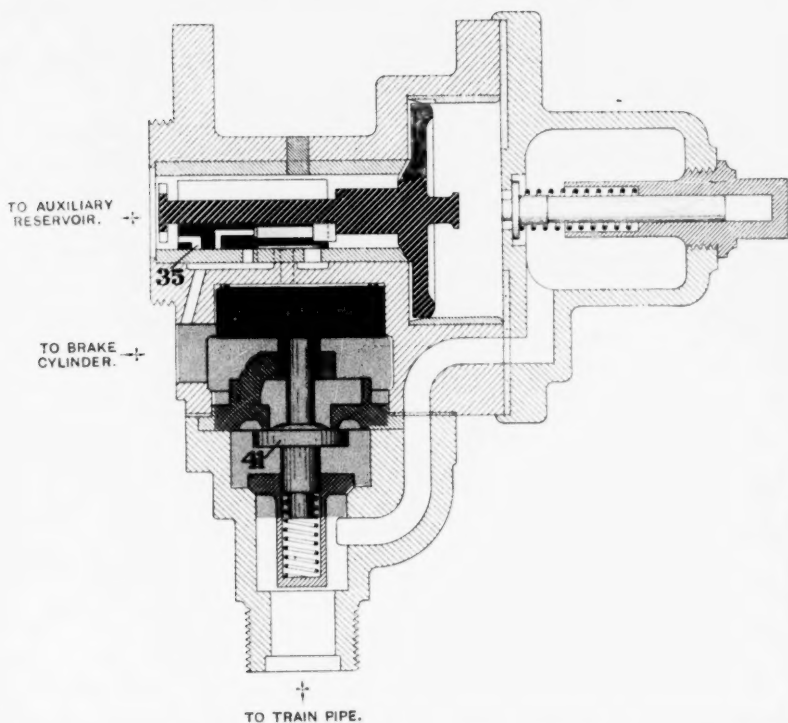
- 1, The old triple-valve parts of patent 220,556, which has expired;
- 2, A special by-passage leading directly from the train-pipe to the brake-cylinder;
- 3, A special "auxiliary-valve" to control said by-passage.

It also appears that the patent 376,837 differs from patent 360,070 by the former having:

- 1, An additional piston-chamber at the side of the triple-valve piston-chamber;
- 2, A "supplemental piston" arranged to be actuated by auxiliary-reservoir air;
- 3, And by actuating the "auxiliary-valve" by the "supplemental piston" instead of by the triple-valve piston, as in 360,070.

In other words, the invention of patent 376,837 consisted in combining the old triple-valve of patent 220,556, the new

Successful Device of the Later Patent, No. 376,837 of 1888.



The Triple Valve of this device is substantially the same as Patent 220,556, and 360,070. This device differs from Patent 360,070 here in suit and which was unsuccessful that the "Auxiliary Valve 41" is actuated by a supplemental piston instead of being actuated directly by the Triple Valve Piston.

The supplemental piston and its chamber are colored brown, and the "Auxiliary Valve 41," and by-passage of 360,070 are colored red.

auxiliary-valve and by-passage of patent 360,070, with a *supplemental piston* and piston-chamber as a motor apparatus for actuating said auxiliary-valve, thereby relieving the piston of the triple-valve from this *extra* work, and thus, as stated by Judge Townsend, in discussing these *two* patents in the New York air-brake suits, "his *later* 376,837 patent was the *bridge*, and not a step, which carried railroad car-builders from FAILURE to success."—(63 Fed. Rep., 969.)

WHAT IS 360,070 ENTITLED TO COVER?

In view of the foregoing facts, the question is, what invention was patent 360,070 entitled to cover? We answer:

It was *not* entitled to broadly cover the prevention of "shock" in long trains, because it did not prevent shock, for the test at Burlington showed it greatly increased it. It was *not* entitled to cover the local venting of the train-pipe at each car in order to quicken the serial or successive applications of the brakes along the train; because that principle had been made public in the prior patent of Mr. Westinghouse, No. 217,838, dated July 22, 1879. It was *not* entitled to cover the utilization of the "extreme traverse" of the triple-valve piston for the purpose of making emergency stops; because that had commonly been done for many years in patent 220,556 and others.

It *was* entitled, however, to cover a mechanical device, namely, the auxiliary-valve 41 governing a special by-passage leading directly from the train-pipe to the brake-cylinder—a device which, although of no utility as arranged in patent 360,070, became afterward exceedingly useful when further combined with the supplementary piston, of patent 376,837. In other words, patent 360,070, while not solving the problem of quick-action, furnished for its subsequent solution by Mr. Westinghouse an important *factor*, consisting of the auxiliary-valve and its by-passage, arranged to be put into action by the "extreme traverse" of the triple-valve piston. This patent, 360,070, did not itself accomplish the desired result; but it furnished an *element* for the subsequent combination by which Mr. Westinghouse finally achieved that result. *It should be construed, therefore, as a patent for that element or factor broadly, and for nothing more.*

LEGAL CONSTRUCTION OF PATENT 360,070.

If, now, we carefully examine patent 360,070, we shall find that it covers that element, the auxiliary-valve and by-passage in combination with the old automatic brake elements.

The specification commences (page 782), with a statement of the invention, and then describes, in a general way, the old plain triple-valve—this part of the description running to the top of page 784. It then says, on page 784 (the italics being ours):

“So far as the performance of its preliminary function
“in ordinary braking is concerned—that is to say, effect-
“ing the closure of communication between the main
“air-pipe and the auxiliary-reservoir and the opening of
“communication between the auxiliary-reservoir and the
“brake-cylinder in applying the brakes, and the reverse
“operation in releasing the brakes—the triple valve 10
“accords substantially with that set forth in letters patent
“of the United States No. 220,556 granted and issued to me
“October 14, 1879, and is NOT, THEREFORE, *saving as to*
“*the structural features by which it performs the further*
“*function of effecting the direct admission of air from*
“*the main air-pipe to the brake-cylinder*, as presently to
“be described, CLAIMED as of my present invention.
“Certain of its elements devised and employed by me
“prior thereto will, however, be herein specified in order
“to render its construction and operative relation to other
“members of the brake mechanism fully intelligible.”

This is a plain and emphatic direction, by Mr. Westinghouse himself, as to *how* the claims are to be construed. They are to be construed as covering only the “*structural features*” by which the direct admission of air from the train-pipe to the brake-cylinder is effected.

The specification then proceeds, to the bottom of p. 785, to describe in greater detail the devices which correspond to those of the old plain triple-valve, including the graduating valve 29 and the restricted port 35 through the main valve 14; after which, not content with the emphatic statement above quoted, it again says:

"So far as hereinbefore described, the triple-valve accords in all substantial particulars with and is adapted to operate similarly to those of my letters patent Nos. 168,359, 172,064, and 220,556, and, in order that it may perform the further functions requisite in the practice of my present invention, it is provided with *certain additional members*, which will now be described."

In the next twenty-two lines following the paragraph last quoted, the specification describes the new auxiliary-valve 41 and its check-valved by-passage, 42, 43, 46, 47, 48, as the said "additional members" by which the new functions of the structure are performed.

Following this is a long description of the operation of the structure, a disclaimer, and the claims.

We have already seen that the *invention* was limited to the *additional* element or factor, the new auxiliary-valve 41 and its by-passage, for effecting the direct admission of air from the train-pipe to the brake-cylinder; we now see that the *patent* limits itself to this new element or factor, both by declaring that it is this *new* factor which produces the desired result, all else being old, including the two traverses of the triple-valve piston, and by directing that the claims are to be construed as for these "*structural features*" by which this result is accomplished.

Whatever claims the patent may contain, therefore, must be construed in the light of these statements found in the patent itself. The stream can rise no higher than the source—the patent can claim nothing beyond the invention.

The claims in suit are as follows :

"1. In a brake mechanism, the combination of a main air-pipe, an auxiliary reservoir, a brake-cylinder, a triple-valve, and an auxiliary-valve device, actuated by the piston of the triple-valve and independent of the main valve thereof, for admitting air in the application of the brake directly from the main air-pipe to the brake-cylinder, substantially as set forth.

"2. In a brake mechanism, the combination of a main air-pipe, an auxiliary reservoir, a brake-cylinder, and a

"triple-valve having a piston whose preliminary traverse
 "admits air from the auxiliary reservoir to the brake-
 "cylinder, and which, by a further traverse, admits air
 "directly from the main air-pipe to the brake-cylinder,
 "substantially as set forth.

* * * * *

"4. The combination, in a triple-valve device, of a
 "case or chest, a piston fixed upon a stem and working in
 "a chamber therein, a valve moving with the piston-stem
 "and governing ports and passages in the case leading to
 "connections with an auxiliary-reservoir and a brake-
 "cylinder and to the atmosphere, respectively, and
 "an auxiliary-valve actuated by the piston-stem and con-
 "trolling communication between passages leading to
 "connections with the main air-pipe and with the brake-
 "cylinder, respectively, substantially as set forth."

It will be observed that *these three claims are for one and the same invention*, being merely different expressions thereof.

There can be no question as to the proper legal construction of claims 1 and 4, both of which are, in terms, expressly limited to a combination containing the new *auxiliary-valve*, and also containing (in claim 4 expressly, and in claim 1 by necessary implication) the by-passage governed by said valve.

The Defendants, as we shall hereinafter show, *do not employ an auxiliary-valve or by-passage, nor any mechanical equivalent thereof, for admitting train-pipe air to the brake-cylinder*. Judge Morris, of the Circuit Court, so held, and the Circuit Court of Appeals affirmed his ruling on this point.

The Complainants, however, contend that *claim 2* is to be broadly construed as covering any triple-valve in which the old *further traverse* of the piston is retained in making an emergency stop where the train-pipe air is admitted directly to the brake-cylinder, whether by means of the auxiliary-valve and by-passage, or their mechanical equivalent, or by any other means whatsoever. On this question Judge Morris held, in substance, that claim 2 is entitled to cover not only mechanical, but *functional* equivalents, and that, therefore, the Defendants' apparatus, while not an infringement of claims 1 and 4 (because it does not contain the auxiliary-valve and by-passage, or their mechanical equivalents), falls within the scope of claim 2,

because it produces the same *result* by other means. The Circuit Court of Appeals strongly disaffirmed this conclusion, both as contrary to law and as evidently based by Judge Morris upon his erroneous belief that the patent in suit was the first to show a triple-valve piston having a partial traverse for graduation and a further or extreme traverse for emergency stops.

The whole controversy in the Supreme Court hangs upon the question whether the Circuit Court of Appeals was right in its conclusion upon this point, or whether Judge Morris was right.

That the Circuit Court of Appeals was right, appears conclusively, we submit, from the following facts:

1. The invention of patent No. 360,070 did *not* consist in giving the triple-valve piston a partial traverse for graduation and a "further traverse" for emergency stops; because automatic triple-valves for years prior to patent 360,070 contained and used that feature, as we have already shown, and as the Circuit Court of Appeals conclusively demonstrated in the paragraph commencing on p. 879 and ending on p. 880. Moreover, the specification of patent 360,070 makes no claim to any novelty in such feature, but asserts repeatedly that the triple-valve itself, apart from the auxiliary-valve 41 and its by-passage, "accords in all substantial particulars with, and is adapted to operate similarly to, those of my letters patent Nos. 168,359, 172,064 and 220,556" (p. 78), "and *is not*, therefore, saving as to the *structural features by which it performs the further function* of effecting the direct admission of air from the main air-pipe to the brake-cylinder, as presently to be described, *claimed* as of my present invention." (Page 784).

To assert any novelty, therefore, in the partial traverse and further traverse, is to assert not only what is not true in fact, (H. H. Westinghouse, p. 307, Aus. 488) but what is expressly denied to be true in the patent itself.

2. The patent also clearly and positively declares that the invention resides solely in the *addition* of the auxiliary-valve

41 and its by-passage, to the old well-known triple-valve. It resides in the "structural features" by which the old triple-valve "performs the further function of effecting the direct admission of air from the main air-pipe to the brake cylinder" (p. 784), and in the "*certain additional members*" by which the old triple-valve is enabled to "perform the further functions requisite in the practice of my present invention" (p. 786). Without these "structural features" or "additional members," the invention of Mr. Westinghouse is not present. The claims no matter how they may read, must, by legal construction, be limited to the *invention*—otherwise they would be invalid. So limited, they only cover combinations containing an auxiliary-valve 41 and its by-passage, or their mechanical equivalents; and are not infringed by the defendants.

3. In any event, the auxiliary-valve and its by-passage must be read into claim 2, in order to prevent the claim from being void as covering a mere *function or result* independently of the means for its accomplishment.* The claim refers to "a *piston* (the old piston) whose preliminary traverse admits air from the auxiliary-reservoir to the brake-cylinder, and which by a further traverse admits air directly from the main air-pipe to the brake-cylinder." *The piston does no such thing.* Its function on the further traverse is to move the main-valve 14 and also *to move the auxiliary-valve 41*, and it is the latter, together with its by-passage, which "*admits air directly from the main air-pipe to the brake-cylinder.*" Without the auxiliary-valve 41, the *piston* is the same old piston which had been known, used, and patented, many years before the patent in suit, and a claim upon it in patent 360,070 would certainly be invalid. It is perfectly clear, therefore, that the auxiliary-valve 41 and its by-passage must be read into claim 2, in order to save the claim from being functional, to make it include the *necessary* elements for accomplishing the result, and to

* Whether they can properly be read into claim 2 involves a serious question of law, which is discussed by Mr. Church in another brief herewith filed. If they can *not*, the claim is clearly invalid; if they *can*, we do not infringe it. The object of the present brief is to discuss only the question of infringement, leaving the other question to Mr. Church's brief.

differentiate it from the old structure of patent 220,556, which employed the *same* piston having the *same two traverses*. The expression, "whose preliminary traverse admits air from the auxiliary-reservoir to the brake-cylinder, and which by a further traverse admits air from the main air-pipe to the brake-cylinder," is simply the expression of a *result*; and that expression must be translated or interpreted into the mechanical means which produce the result, or else the claim must be held void. (*O'Reilly vs. Morse*, 15 How. 62, 119). So translated, this claim is not limited to less than what Mr. Westinghouse invented; but it does complete justice to him, fully covering everything which he added to the old triple-valve or which he described in his specification as new.

The claim must also be so translated as above, in order to give effect to its concluding words, "*substantially as set forth*." Mr. Westinghouse "set forth" no other means of producing the result, except the auxiliary-valve 41 and its by-passage. These words, therefore, become idle and meaningless except as a direction to the court to construe the auxiliary-valve and by-passage into the claim.

"Where the claim immediately follows the description
"of the invention, it may be construed in connection with
"the explanation contained in the specifications; and
"where it contains words referring back to the specifications,
"it cannot properly be construed in any other
"way."

Seymour vs. Osborne, 11 Wall., 547.

Miller vs. Eagle Mfg. Co., 151 U. S., 186, 202.

The Complainants are simply endeavoring to expand the second claim *beyond the invention* of Mr. Westinghouse and to make it include the accomplishment of the result by means which do not involve an auxiliary-valve and by-passage, but act upon an altogether different principle and by a totally different mode of operation.

4. Our position is strongly confirmed by certain admissions found in the Complainants' brief used in the Circuit Court of

Appeals for the Fourth Circuit. Thus, on page 40 of that brief, Complainants' counsel say :

" Thus it will be seen that this quick-action *attachment*, consisting of an *air-conduit or passage-way directly from the train-pipe connection to the brake-cylinder and a valve to control it*, such valve being itself under control of the triple-piston and so combined with the old automatic brake appliances that not interfering with the ordinary use of the latter it, the quick-action *attachment*, may be used as an *auxiliary* emergency device in the presence of great or serious danger—that *this*, the chief novelty and element of utility of the Westinghouse invention now in controversy, *is so made the subject matter of every claim in controversy as to give character and effect thereto*, and render the scope of the claim co-extensive with the invention."

Again, on page 31 of the same brief, the distinguished counsel for Complainant, after describing the old automatic triple-valve, refer to the new invention of patent 360,070 in the following words :

" Westinghouse added to and combined with this brake *another brake mechanism*, which, on account of its novel predominant characteristic or function, has given to the whole apparatus its own name of *quick-action* or *emergency brake*—both names being used. And he so combined these two mechanisms, 'the service' and 'the quick-action; that while, in fact, they constitute *two machines*, they are also included in a *single structure*, and are put into a co-acting or co-operating mechanical relation with each other, as will presently appear."

Counsel here mean that the old triple-valve was one machine, and the new auxiliary-valve 41, with its by-passage, was *another* "machine," and that the invention of patent 360,070 consisted in the combination of these two machines in one structure—a statement with which we entirely agree, and with which the

Circuit Court of Appeals, for the Fourth Circuit (p. 876), fully concurred. But it follows that machine No. 2 is a necessary element of the combination; that it must, by legal construction, be read into any claim which does not already express it, and that there can be no infringement where the defendant does not use it. These two admissions are conclusive as to the whole controversy over the legal construction of claim 2.

5. Our position is also conclusively confirmed by the exhibit, "*File - Wrapper and Contents*," of patent No. 360,070 (pp. 705 to 724).

It appears from this exhibit that the application for the Westinghouse patent was filed November 19, 1886; that the broad claim 1 and the more limited claim 2 were both rejected on the prior patent of Boyden, dated June 26, 1883, No. 280,285, and that on January 19, 1887, Mr. J. Snowden Bell, attorney for Mr. Westinghouse, wrote a letter to the Patent Office in which he erased the original broad claim 1 and substituted the present narrower claim 1, and made an argument in favor of the allowance of claim 2. In this argument he says (p. 718, near the bottom):

"It is to be understood that applicant (Westinghouse) *does not seek to broadly claim* a device for admitting "air directly from the main air-pipe to the brake-cylinder, "as the four-way cock long heretofore employed by him " (similar to the cock *K* of the Boyden patent) would be "a structure of such character. *When, however, the "triple-valve is provided with an auxiliary-valve operated "by its piston, which performs a new function addi- "tional to that of the triple-valve as previously employed, "it is believed that such combination is wholly novel."*

The above statement in the Patent Office file, on which claim 2 was reconsidered and allowed, undoubtedly operates, in law, to read the auxiliary-valve into claim 2; and it is a question whether it does not also operate to further limit the auxiliary-valve to one which is actuated by the direct impact

of the piston-stem, as described and shown in the patent. However the latter may be, it is certain that, in view of this statement of Westinghouse's Attorney, and of repeated decisions of this high tribunal as to the legal effect of such admissions made during the progress in the Patent Office of an application for letters patent, no court can rightly construe claim 2 as a broad claim unlimited to the "Auxiliary-Valve 41."

Moreover, claim 1 of the application was originally as follows:

"1. In a brake mechanism, the combination of a main air-pipe, an auxiliary-reservoir, a brake-cylinder and *a triple-valve provided with a device* for admitting air directly from the main air-pipe to the brake-cylinder, substantially as set forth."

This broad claim (p. 714) was withdrawn (bottom of page 717), and the present claim 1 was substituted, limited in terms, to "an auxiliary-valve," "actuated by the piston of the triple-valve," and "independent of the main-valve thereof."

Again, the specification, as originally filed, contained the following broadening statement (top of p. 714):

"Further, while in the specific construction described and shown, the function of admitting air from the main-pipe is performed by a valve separate from that which effects the preliminary admission of reservoir-pressure to the cylinder, a modification in which the same office is performed by a valve integral with the main-valve and formed by an extension thereof, would be included in and embody the essential operative features of my invention."

This clause, also, was stricken out during the progress of the application through the Patent Office; so that the legal construction of the patent, as issued, is, that the auxiliary-valve must be separate from the main-valve and not formed by an extension thereof.

We see, then, *first*, that the invention of patent 360,070 was not, in and of itself, a solution of the problem of "quick-action" or of the prevention of shock in long trains, but merely furnished a device which, in combination with other devices subsequently invented, became a useful factor in Mr. Westinghouse's

later invention of patent 376,837; *second*, that whatever invention was contained in patent 360,070 consisted only in *adding* the auxiliary-valve 41 and its by-passage to the old triple-valve; *third*, that the specification of patent 360,070 described the invention as consisting merely in this addition, and directed the claims to be construed as limited thereto; *fourth*, that claim 2 must be held invalid unless the auxiliary-valve and by-passage are read into it; *fifth*, that Complainants' counsel admit that the auxiliary-valve and by-passage are "so made the subject matter of every claim in controversy as to give character and effect thereto"—the invention consisting practically in the combination of "*two machines*," one of which is the old triple-valve, and the other the new devices added to it by Mr. Westinghouse; and *sixth*, that while the application was pending in the Patent Office, Mr. Westinghouse, through his attorney, confined the invention to the new auxiliary-valve actuated by the piston of the triple-valve, and struck out all broad claims and broadening statements of the specification which might be in conflict with that theory.

It would seem that further argument on this point was unnecessary, but we cannot leave the subject without commending to the attention of the court the masterly reasoning of the Circuit Court of Appeals below, which fully sustains our position in every respect, nor without calling the attention of the court to the case of *The Westinghouse Air Brake Co. vs. The New York Air Brake Co.*, in the Southern District of New York (69 Fed. Rep., 71⁷; 16 C. C. A., 371, 373, 374, 376).

NEW YORK SUIT.

In that case Judge Lacombe (16 C. C. A. 371), referring to patents 360,070 and 376,837, said that they "disclosed the one, the emergency valve" (meaning auxiliary-valve 41), "the other the supplemental piston or special motor, which, so far as the art has now progressed, appear to be both essential to the structure of a successful quick-action air-brake."*

*The Boyden brake used by defendants here was not before Judge Lacombe, and he was ignorant of the fact that Boyden had solved the problem of quick action by *another plan* not involving the use of either an auxiliary-valve or a supplemental piston.

Then, on page 373, 16 C. C. A., referring to claim 1 of patent 360,070, Judge Lacombe said :

“The means for actuating the auxiliary-valve device “is stated in the claim to be ‘the piston of the triple-
“valve.’ And the way in which it acts, as shown in the
“patent, is by direct impingement upon the stem of the
“auxiliary-valve device.”

On page 374, same volume, referring to claim 2 of patent 360,070, he said :

“The discussion of the first claim *applies equally to*
“*this one.* In the first claim, actuation by the piston
“of the triple-valve was made an element. In this
“claim the inventor *more closely limits the mode of*
“*such actuation.* It is to be by a ‘further traverse’ of
“that ‘piston.’”

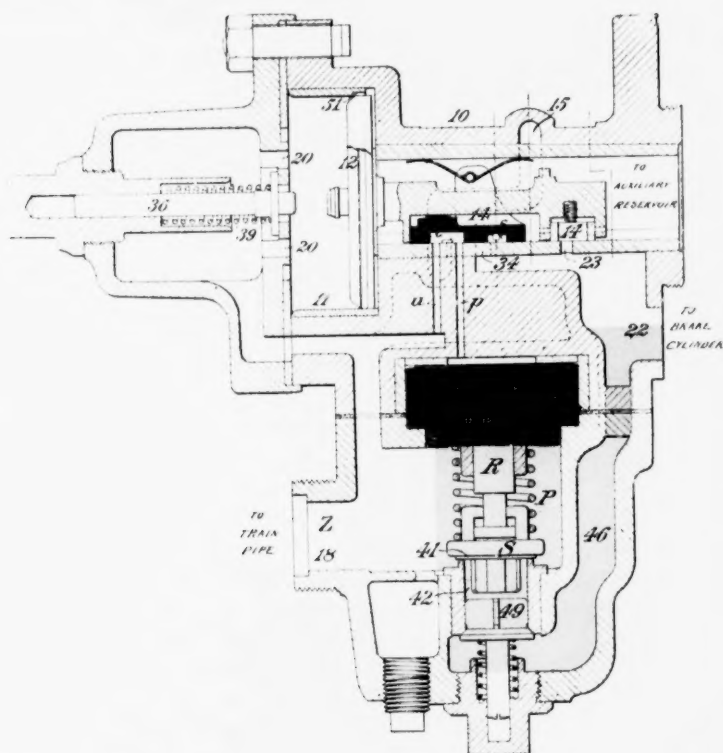
The Defendant in that case used the “auxiliary-valve” device, but actuated it *indirectly* by the piston of the triple-valve, and was found guilty of infringement. (See cut of New York Company's valve structure on opposite page. The auxiliary-valve device is shown in red.)

The Circuit Court of Appeals for the Second Circuit affirmed the decision of Judge Lacombe (16 C. C. A., 376), saying, with respect to patent 360,070, simply, that they “deem it unnecessary to add anything to the opinion of Judge Lacombe.”

It therefore clearly appears that Judge Lacombe, the Circuit Court of Appeals for the Second Circuit, and the Circuit Court of Appeals for the Fourth Circuit, are all in full accord with us on the proposition of law that the auxiliary-valve 41 must be read into claim 2 of patent 360,070. So construed, all the claims in suit are limited to the auxiliary-valve 41; and it only remains to show that the Defendants here do not use such valve or any mechanical equivalent thereof.

New York Brake Co.'s Valve.

Held to infringe by Judge Lacombe because it contained the "Auxiliary Valve" device (shown in red) of Patent 360,070.



The "Auxiliary Valve 41" of Patent 360,070 is shown in red, and the "Supplemental Piston" and chamber of Patent 376,837 shown in brown.

Defendants Triple Valve Structure.

With the Immovable Partition 9 inserted.

Fig. 1. Release Position.

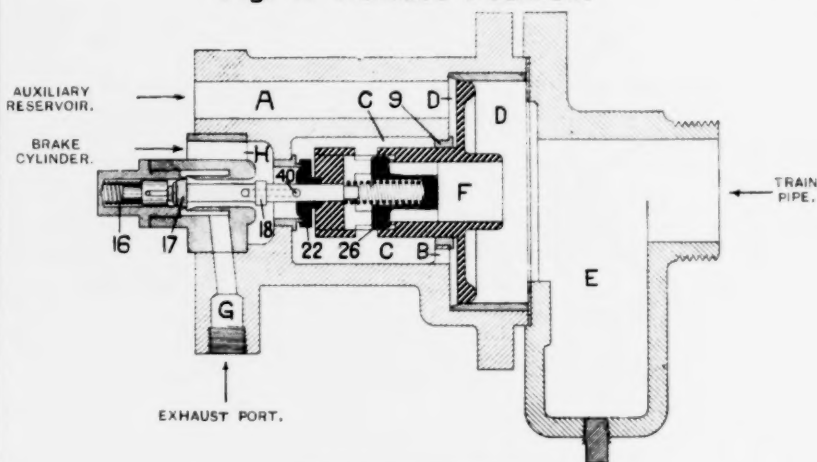


Fig. 2. Quick-Action Position.

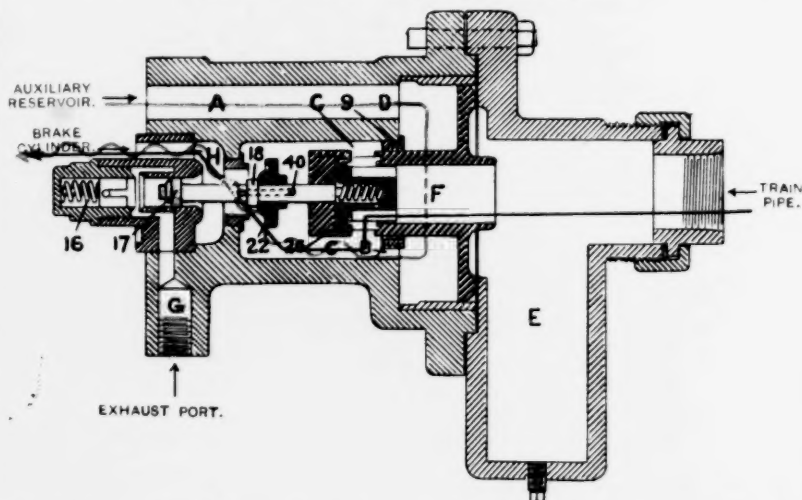


Fig. 2 shows the Defendants Triple Valve Structure in the quick-action position, and the Main Valve 22 in the act of admitting both Train Pipe and Auxiliary Reservoir airs to the Brake Cylinder.

The course of the Train Pipe Air is shown by a Blue line, and that of the Auxiliary Reservoir Air by a Red line. It will be noted that both airs commingle in the Triple Valve Chamber C, and together pass to the Brake Cylinder through the port opened by the Main Valve 22 (black), thereby not requiring an Auxiliary Valve to admit the Train Pipe Air.

THE DEFENDANTS' QUICK-ACTION AIR-BRAKE.

The Defendants are charged with infringing claims 1, 2 and 4 of patent 360,070, by making, selling and using a brake apparatus like that patented to George A. Boyden, August 16, 1892, Nos. 481,134 and 481,135 (pages 797 and 809), the respective applications for which patents were filed in the Patent Office, the first one September 30, 1889, before this suit was brought, and the second one March 6, 1891.

The Defendants' device is illustrated in the cuts printed on the opposite page.

In this device no auxiliary valve or by-passage is employed; but the quick-action result is effected simply by properly proportioning the ports and passages of the old plain triple-valve and using a fixed partition (9) to divide the piston chamber D from main-valve chamber C. With the ports and passages of the old triple-valve properly proportioned, the partition 9 is the element which produces "quick action" in the Boyden structure. The partition is not a valve nor the mechanical equivalent of a valve, but is merely a metal ring screwed immovably into the triple-valve casing, and serving to divide the piston-chamber from the main-valve chamber. It was a new element never before found in triple-valves, and it introduced a new principle and mode of operation totally different from anything ever invented by Mr. Westinghouse or any other inventor. It involved a new and brilliant discovery and invention on the part of Mr. Boyden, of masterly ingenuity and originality.

The effect of the partition 9 is to make the main-valve 22 (black) of the triple-valve admit the train-pipe air to the brake-cylinder at the same time it admits the auxiliary-reservoir air thereto. The simultaneous admission of the two airs through the port of the main-valve 22 is shown by colored lines in Fig. 2, on opposite page.

In embodying this new principle, Mr. Boyden adopted the general form of triple-valve shown in the expired Westinghouse patent, No. 141,685, dated August 12, 1873 (p. 736) in which the main-valve 22 is of the poppet form, and a separate valve 17 controlled by a rod sliding through the main valve is employed for releasing the brakes. For charging the auxiliary-reservoir, he adopted, from the expired Westinghouse patent No. 144,006,

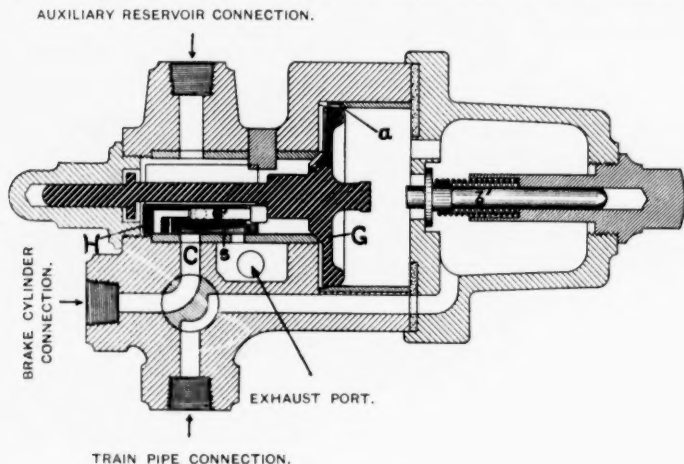
dated October 28, 1873, (p. 740), a check-valved feed passage through the triple-valve piston (Hogan, p. 284, Ans. 413); but arranged the feed passage and its check-valve 26, in a tubular extension F, of the piston, and substantially in the form shown in Fig. 3 of his own patent, No. 280,285, dated June 26, 1883 (p. 776, and see cuts opposite to p. 498). He also provided a sensitive graduating valve, similar in results to the graduating valve e¹ of the now expired Westinghouse Patent, No. 220,556, dated October 14, 1879, by so arranging a small passage 40 in the sliding-stem which actuates the release-valve that said passage will be opened and closed by the sliding of said stem through the main-valve 22. As thus constructed, the triple-valve operates in all respects substantially the same as that of patent 220,556, and like the latter, is incapable of "quick-action."

The two cuts on opposite page represent respectively the old plain triple-valve patent No. 220,556 and Defendants' structure *without* the partition 9. The corresponding valves in both cuts are colored alike in order that they may be readily located in the following analogy :

ANALOGY.	Defendants' Structure.	Patent No. 220,556.
In both there is a feeding-in-valve (<i>blue</i>) to charge the auxiliary-reservoir— designated.....	26	a
In both there is a graduating-valve (<i>yellow</i>) which is opened by the "preliminary traverse" of the piston to admit auxiliary-reservoir air to the brake-cylinder—designated.....	40	e ¹
In both there is a main valve (<i>black</i>) which is opened by the "further traverse" of the piston to also admit auxiliary-reservoir air to the brake-cylinder—designated.....	22	H
In both there is a release-valve (<i>green</i>) which discharges air from the brake-cylinder to the atmosphere—designated.....	17	s

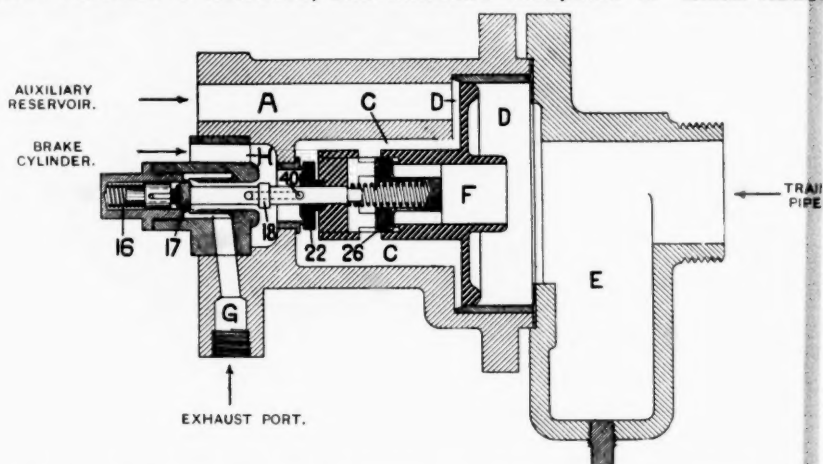
Both of these devices are plain "triple-valves" incapable of

Triple Valve of Patent 220,556 of 1879.



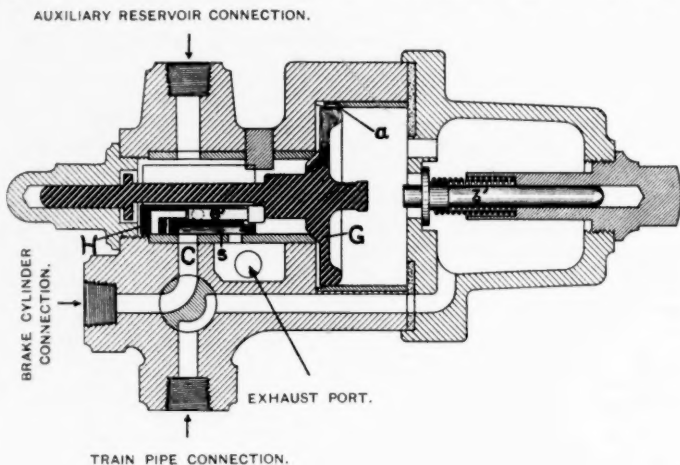
Defendants Triple Valve Structure

With Partition 9 Removed, and therefore incapable of Quick-Action



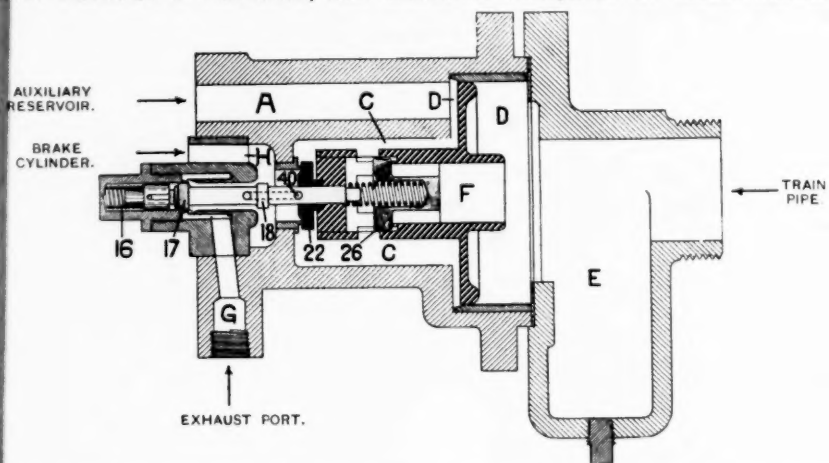
In both structures there are four valves—Feeding-in Valve, Blue; Graduating Valve, Yellow; Release Valve, Green, and Main Valve, Black. The valves all functionate as Triple Valves, and it follows that if said valves are "Triple Valves" in 220,556, they are also Triple Valves in defendants structure. The piston in both has a "preliminary traverse" and "further traverse," the two traverses being old, and used since 1873.

Triple Valve of Patent 220,556 of 1879.



Defendants Triple Valve Structure

With Partition 9 Removed, and therefore incapable of Quick-Action



In both structures there are four valves—Feeding-in Valve, Blue; Graduating Valve, Yellow; Release Valve, Green, and Main Valve, Black. The valves all functionate as Triple Valves, and it follows that if said valves are "Triple Valves" in 220,556, they are also Triple Valves in defendants structure. The piston in both has a "preliminary traverse" and a "further traverse," the two traverses being old, and used since 1873.

"quick-action," the operation of 220,556 being described on pp. 5, 6 and 7 of this brief. They each produce exactly the same result, and each of the four valves in the two devices perform the same function. If the said valves in 220,556 are "triple-valves," it follows that the corresponding valves in Defendants' structure are *also* triple-valves.

Each structure has a piston with a "preliminary traverse" to open the graduating-valve (yellow) to partially or slowly apply the brakes, and a "further traverse" to open the main-valve (black) for a quick or an emergency application of the brakes. Both these devices are old and public property. The Defendants' device, as here shown, does *not* contain the "partition 9."

Starting from this point, Mr. Boyden, with the *poppet* form of the old triple-valve 141,685, before described, and Mr. Westinghouse, with the triple-valve of patent 220,556, both inventors sought to solve the problem of "quick action," but they proceeded in very different directions, and by respectively calling to their aid means which are so unlike as to be absolutely incapable of comparison with each other, and of which the Circuit Court of Appeals, in its opinion (p. 880), said:

*"They seem to us to differ as widely from each other
"as two devices for accomplishing the same result can
"well differ."*

Mr. Boyden conceived the idea of developing the *latent* capabilities of the valves of the old triple-valve by *creating therein special differential pressures*, so that *these same valves* will have the *new power* of admitting train-pipe air to the brake-cylinder for emergency applications of the brakes. Mr. Westinghouse had the idea of retaining the old triple-valves to do no more than their old functions, and in order to obtain the new object he conceived the plan of *adding* a new auxiliary-valve 41 and its by-passage to the old triple-valve of patent 220,556, thereby, as Complainants' counsel admit, adding a *new "machine"* to the old one, and combining both together in one structure; and he produced, *not* "quick-action," but an "auxiliary valve" device, which, at a later period, became a *factor* of paramount importance to him in the production of quick action.

Mr. Boyden added no new valve or by-passage—no new *machine*—but he simply connected his auxiliary-reservoir to

the inner end of the *piston-chamber* by means of a capacious passage *A*, and divided said piston-chamber from the main valve chamber by a partition 9 having a passage *B* the capacity of which was less than that of the passage *A*, and intermediate in size between that of the graduating passage 40 and that of the port covered by the main valve 22—and he thereby produced a perfect quick-action triple-valve.

The operation of the Boyden device was as follows :

Recharging the auxiliary reservoir and releasing the brakes.—The engineer accomplishes these functions, as in all automatic air-brakes, by increasing the pressure in the train-pipe. This forces the triple-valve piston to the inner end of its traverse (as shown in the upper cut opposite p. 35), unseating the release-valve 17 and releasing the brakes, seating the main valve 22, and closing the graduating port 40. The pressure of train-pipe air now lifts the feed-valve 26 (as in Westinghouse patent No. 144,006 and Boyden patent No. 280,285), and flows into the main-valve chamber *C*, whence it passes back through the restricted opening *B* into the space between partition 9 and the triple-valve piston, and thence flows through passage *A* to the auxiliary-reservoir. When the pressure in the train-pipe reaches its maximum of 70 pounds and ceases to further increase, the check-valve 26 becomes seated by its spring, thereby preventing any reflux of air from the auxiliary-reservoir to the train-pipe; and the pressures equalize in the auxiliary-reservoir, the main-valve chamber, and the passages connecting them. The apparatus is now in its normal running condition.

Graduating.—The engineer effects this function, as in all automatic air-brakes, by discharging about 10 pounds of air-pressure from the train-pipe. The superior pressure of the auxiliary-reservoir now moves the triple-valve piston through its partial traverse, thereby causing the release-valve 17 to seat and close communication between the brake-cylinder and the atmosphere. At the same time, the piston, by said partial traverse, draws its own stem back through the main-valve 22 far enough to open the graduating port 40 and allow auxiliary-reservoir air to flow slowly into the brake-cylinder and set the brakes with a light pressure. The auxiliary-reservoir pressure in the valve chamber *C* meanwhile holds the main-valve 22 so

firmly seated that when the collar 18 on the piston stem strikes the main-valve it does not unseat the latter, but merely arrests the movement of the piston, thereby limiting the latter to its partial traverse. The passage *B*, being larger than the graduating port 40, supplies more air than can escape through the latter, and therefore maintains an equality of pressure between the auxiliary-reservoir and the main-valve chamber. This pressure slowly decreases by the vent through port 40 into the brake-cylinder, and when it becomes slightly lower than the train-pipe pressure (now 60 pounds), the latter moves the piston back far enough to close port 40. The piston cannot move far enough, however to open the release port, because, in attempting to do so it would necessarily have to compress, and thereby increase the resistance of, the auxiliary-reservoir air (which is now confined without means of escape), and also because of its own friction. If the engineer desires to increase the pressure of his brakes, he discharges a few more pounds of air from the train-pipe, and the operation above described is repeated; and so on, till he reaches any degree of brake-pressure required for slacking the speed of the train or bringing it to a "service-stop," as the case may be. He releases the brakes and recharges the auxiliary-reservoir by increasing the train-pipe pressure to its normal 70 pounds.

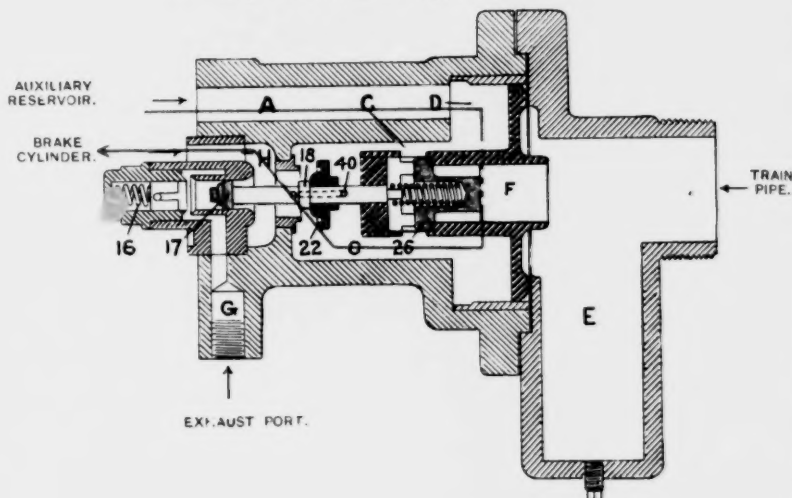
Making an Emergency Stop.—When the engineer discovers danger closely impending, he instantly throws his governing-valve wide open. This suddenly vents a larger amount of air (15 or 25 pounds) from the train-pipe. The auxiliary-reservoir pressure on the first car is now so greatly in excess of the train-pipe pressure that the preponderance instantly forces the triple-valve piston to the extreme outward limit of its traverse, thereby causing the main-valve 22 to unseat and fully open its port, so that auxiliary-reservoir air can flow rapidly and freely to the brake-cylinder to set the brakes with maximum quickness and force.

Up to this point every operation and result have been precisely the same as those of the old automatic air-brakes in use prior to the date of the patent in suit—1887. But now a new action takes place, peculiar to the new Boyden brake, and constituting its new principle and mode of operation, The port of the main-valve 22 is so much larger than the passage B that the pressure in the main-valve chamber C is instantly emptied into the brake-cylinder, and, as the passage B cannot supply air so fast as the main-valve port can exhaust it, the pressure in the main-valve chamber suddenly drops to about 5 pounds. Meanwhile the passage A, leading from the auxiliary-reservoir to the inner end of the piston-chamber, is so much larger than the passage B, leading from the piston-chamber to the main-valve chamber, that full reservoir pressure is maintained in the piston-chamber between the partition 9 and the inner side of the piston, thereby holding the piston back firmly at its extreme traverse. But the feed-valve 26 (blue) is now exposed on the one side to a train-pipe pressure of about 55 pounds, and on the other side to a main-valve-chamber pressure of only about 5 pounds, and therefore valve 26 is instantly forced open by the greater train-pipe pressure, which then vents freely through the said feed-valve port into the main-valve chamber C, where it commingles with the auxiliary-reservoir air passing through said chamber, and both airs pass together through the port opened by the main-valve 22 to the brake-cylinder. The whole operation is substantially instantaneous, and the result is that the train-pipe is freely vented at each car, the time of serially or successively applying the brakes of the several cars from one end of the train to the other is reduced to a minimum, and the train is quickly stopped without shock—a result which Mr. Westinghouse did not attain with the device of patent 360,070, nor did he attain it until he had invented his later apparatus of patent 376,837 not here in suit.

When the Court arrives at a clear understanding of the structure and "mode of operation" of the Boyden brake, it will see at once that, in the Boyden device, the partition 9 is the controlling element which produces "quick action." When this partition is present, the device operates as a quick-action air-brake; but remove the partition, and the device then operates

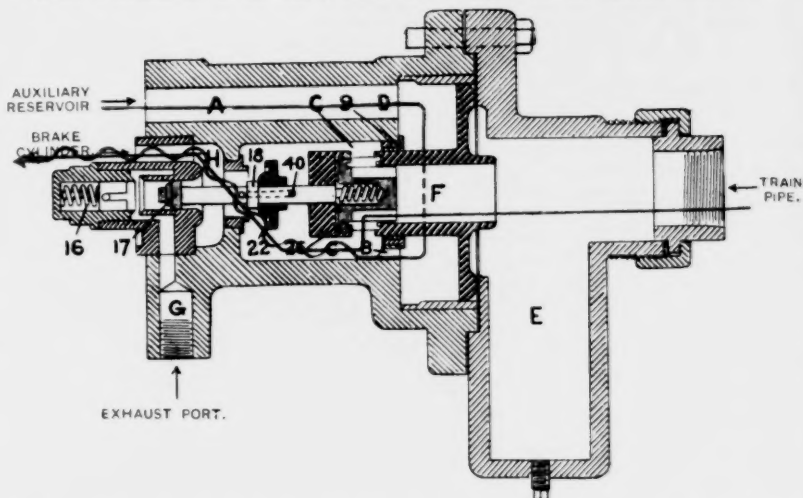
Defendants Triple Valve Structure

With Partition 9 Removed and Incapable of Quick-Action, Operating only as a Plain Triple Valve.



Defendants Triple Valve Structure

With Partition 9 in its Place and Capable of Quick-Action.



In the upper cut the structure operates as a plain Triple Valve, the Main Valve 22 admitting only Auxiliary Reservoir Air to the Brake Cylinder as shown by the Red line, but in the lower cut the structure operates as a Quick-Action Valve. The Main Valve 22 admitting both Auxiliary Reservoir and Train Pipe Air to the Brake Cylinder as shown by the Red and Blue lines.

This great transformation in the operation being due to inserting the partition 9. With the Defendants Structure is a perfect quick-action device without employing any

only as an old triple-valve—precisely like the triple-valve of patent 220,556. (See test'y. of H. H. Westinghouse, p. 336, ans. 601, pp. 345, 346, ans. 647, 648).*

The reason of this is as follows (see cuts on opposite page):

The passage *A* is equal to, or larger than, the port of the main valve 22, and, in the *absence of partition 9* (see Fig. 1), can supply auxiliary-reservoir air to the main-valve chamber *C* as fast as, or faster than, such air can vent from said chamber through the main-valve port to the brake-cylinder. Hence, in the absence of the partition 9, no sudden reduction of pressure in the main-valve chamber *C* is effected by the unseating of valve 22. The result is, that under such condition, the feed-valve 26 cannot be opened, and no train-pipe air can possibly pass into the main-valve chamber. Therefore, only auxiliary-reservoir air is admitted to the brake-cylinder, its course being shown by a red line.

But with the partition 9 in place (see Fig. 2), all this is changed. The opening of the main valve 22 suddenly reduces the pressure of the main-valve chamber *C* to about five pounds; this is due to the partition 9 preventing the auxiliary-reservoir air from freely entering the chamber *C*; the train-pipe air at 55 pounds will instantly pass into the chamber *C* through the feeding-in-valve 26, and thence to the brake-cylinder through the port opened by the main-valve 22 simultaneously with the passage of the auxiliary-reservoir air, thereby making the main-valve perform the two functions. The course of the train-pipe air is shown by a blue line, and that of the auxiliary-reservoir by a red line.

The operation is absolutely certain and reliable; and the invention of Mr. Boyden, by which it is effected, is entitled to rank as a scientific discovery of high order—the discovery that the old-fashioned triple-valve can be operated, simply by *differential pressures*, to produce the important quick-action result which Mr. Westinghouse supposed could be produced only by combining it with *a new machine for that specific purpose*, consisting in a new “auxiliary-valve” actuated by the piston of the triple-valve and controlling an additional by-passage leading from the train-pipe to the brake-cylinder.

*If the Court will permit, we will, with a full-size brake apparatus, operated by air-pressure, give an ocular demonstration of these facts at the hearing.

The Boyden principle is not confined to triple-valves having the main-valve and the release-valve of the "poppet" form, and therefore necessarily separate from each other, but is equally applicable to all other forms of triple valve. If we remove from the Boyden device the poppet main-valve 22 and the release-valve 17, and substitute therefor a slide-valve, exactly as in patent 220,556, with the graduating-valve shown in the latter patent, the result is just the same as with the new Boyden triple-valve above described. The Defendants manufacture triple-valves embodying the same invention in three forms, among which is the slide-valve form, patents for which were all granted on the same day—August 16, 1892, pp. 797-809-817.

THE COMPLAINANTS' ARGUMENT AND THE ANSWER THERETO.

The Complainants' argument is, that the sensitive valve 40 of the Boyden device is the main-valve; and that the valve 22 is only an auxiliary-valve, corresponding to the auxiliary valve 41 of patent 360,070, because it unseats only during the further traverse of the triple-valve piston in making an emergency stop, is unseated by said piston, and, when unseated, admits train-pipe air to the brake-cylinder directly (that is, without said air first passing to the auxiliary-reservoir).

The argument is specious, sounding in words rather than facts; and, when considered with reference to the actual operations of the two mechanical structures under comparison, it is not even plausible on its face. It did not deceive Judge Morris, who said (p. 844):

"In the Boyden mechanism, which is alleged in this case to infringe, I have not been able to satisfy myself

“that Boyden makes use of an “auxiliary-valve” in the
 “sense in which that term is employed in the specifica-
 “tion and in some of the claims of the patent No. 360,070
 “now in suit. * * * * * (p. 845), “and
 “the defendants’ valve 22 must be considered to be the
 “main-valve, and that in Defendants’ mechanism he has
 “been able, *by an ingenious arrangement restricting the*
 “*admission of auxiliary-reservoir air to the triple-valve*
 “*chamber*, to cause the main valve to do *both* main-valve
 “work, when needed, and to do quick-action work, when
 “needed.”

The Circuit Court of Appeals unanswerably refutes the Com-
 plainants’ argument saying (p. 881):

“Boyden’s (22) is not an auxiliary-valve; it is mechan-
 “ically the original main-valve of the original triple-
 “valve, and it performs the service which is performed
 “by the main-valve of 220,556. It is not the mechanical
 “equivalent of valve four” (auxiliary-valve 41) “in the
 “attached apparatus of Westinghouse simply by reason
 “of its taking part in an emergency service in admitting
 “train-pipe air into the brake-cylinder. In the original
 “triple-valve it (the main-valve) performed no other
 “service than admitting auxiliary-reservoir air into the
 “brake-cylinder; in Boyden’s device it continues to
 “perform that service, and is made incidentally instru-
 “mental in allowing the passage of train-pipe air. The
 “performance incidentally of quick-action service does
 “not make it an auxiliary-valve. It is the *same* valve.
 “The incidental *service* is auxiliary, but *the valve itself*
 “*is the same* and unchanged. We think the Circuit
 “Court was correct in its view that the poppet-valve 22
 “of Boyden is the original main-valve of 220,556.”

In the Boyden device, when the *partition 9 is removed* and the triple-valve is therefore capable of acting only as an old-fashioned triple-valve, it cannot for a moment be contended that valve 22 acts otherwise than as the old main-valve (the slide valve) of patent 220,556 (called the "main-valve" in claim 1 of the latter patent), or that the sensitive valve 40 acts otherwise than as the old graduating valve *e*¹ of patent 220,556. In both devices (Boyden and 220,556) the *partial* traverse of the piston leaves the main-valve covering the main-port to the brake-cylinder, but causes the sensitive valve to open a passage *through the main-valve* and admit auxiliary-reservoir air slowly to the brake-cylinder for graduating purposes; while the *further* or extreme traverse causes the main-valve to uncover the main port and admit auxiliary-reservoir air more freely and quickly to the brake-cylinder for emergency purposes.

By now inserting the partition 9, *which converts the Boyden device to a quick-action triple-valve*, the actions, operations and results of the old plain triple-valve structure, as just described, are not changed, but continue still to be performed just as before. Hence, if the valve 22 was a main-valve before, it is a main-valve still. Neither the valve nor its function is changed by the insertion of the partition 9. Its old emergency function was to open the main port fully and admit auxiliary-reservoir air to the brake-cylinder—a function which it still performs in the same way, and under the same circumstances. On the other hand, both in the Boyden device and in patent 220,556, the sensitive graduating valve performs an office which is subordinate to that of the main-valve, its function being, in the language of claim 1 patent 220,556, "to close or open *a port through the main-valve* without necessarily moving the main valve." This office is useful only for graduation. The sensitive valve, in both structures, is substantially *functus officio* when making an emergency stop.

It is a conspicuous fact that the sensitive graduating-valve 40 of Defendants' device corresponds with THAT valve of the patent in suit which the specification terms "a graduating valve 29." (See patent, page 785, bottom of second paragraph.) Therefore the argument of Complainants' counsel, that Defendants' valve 40 corresponds with the "main-valve" of the Patent in suit, is erroneous and misleading, because in fact said valve 40 corresponds with that valve which the Patent states is the "graduating valve 29."

Complainants' arbitrary and false process of classifying the several valves in Defendants' structure—the valve 40 (or i, j, k) as "*main*," and the valve 22 as "*auxiliary*"—leaves no valve in said structure which is classed as the "sensitive graduating valve;" the Court will, therefore, see that the classification itself is specious and altogether erroneous.

There is one slight and immaterial difference between the main valve of Boyden and that of patent 220,556, incidental to the use of a poppet valve for the former and a slide-valve for the latter. A slide-valve, acting both as a release-valve and a main valve, as in patent 220,556, must, in applying the brakes, be first moved slightly to close release-port, before the graduating valve is permitted to vent air into the brake-cylinder; whereas, with a poppet valve, which necessitates a separate release-valve, the latter must first be moved to close the release port, and the former need not move at all during the graduating operation. When Boyden uses the slide form of main-valve, however, this incidental and merely formal difference entirely disappears.

COMPLAINANTS' AND DEFENDANTS' STRUCTURES COMPARED.

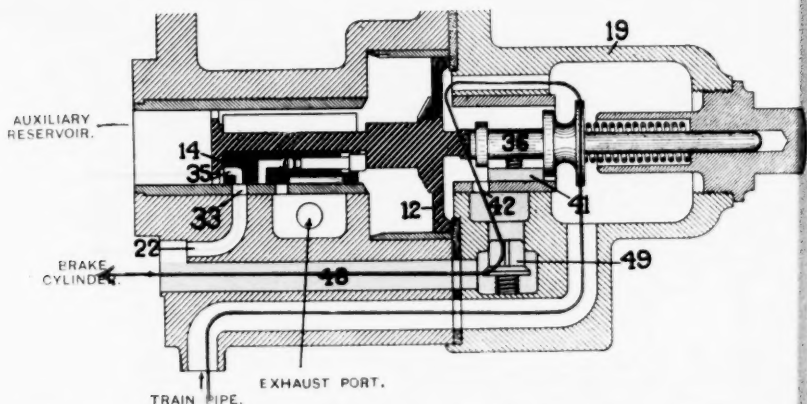
The two cuts on the opposite page represent structures, respectively, of the Complainants and Defendants. In those structures the parts forming the several valves are shown in colors, the corresponding valve in both structures having the same color. The feeding-in-valve is blue; the graduating-valve is yellow; the main-valve is solid black; the release-valve is green. In the Complainants' structure the "auxiliary-valve 41" and by-passage 46 are red.

In the Complainants' structure the piston has to move the graduating-valve (*yellow*), and then the main-valve (*black*) as in the old patent 220,556, and then to move a *third valve (red)* in performing the quick-action function: in the Defendants' structure the piston has to move the graduating-valve (*yellow*) and then the main-valve (*black*) as in the old patent 220,556, but it has to move *no (red or) third valve*—the quick-action being performed by the triple main-valve already moved, due to the partition 9 restricting the flow of auxiliary-reservoir air to the main-valve chamber C.

The course of the two airs (auxiliary-reservoir air and train-pipe air) are shown by colored lines in the cuts.

Fig. 1 shows the Complainants' structure with all the valves in the position they occupy for an "emergency" application of the brakes, wherein the air from the train-pipe (shown by a blue line) passes through a port uncovered by the auxiliary-valve 41, thence through a check valved by-passage (43, 46) to the brake-cylinder. The air from the auxiliary-reservoir (shown by a yellow line) passes through the main-valve port 35, of the triple-valve to the brake-cylinder. Thus, Complainants' structure retains the old main-valve to admit the auxiliary-reservoir air, but employs a new additional valve device to admit the train-pipe air.

Fig. 2 shows the Defendants' structure with all the valves in the position they occupy for an "emergency" application of the brakes wherein the air from the train-pipe (shown by a blue line) passes through the feeding-in-valve passage F into the

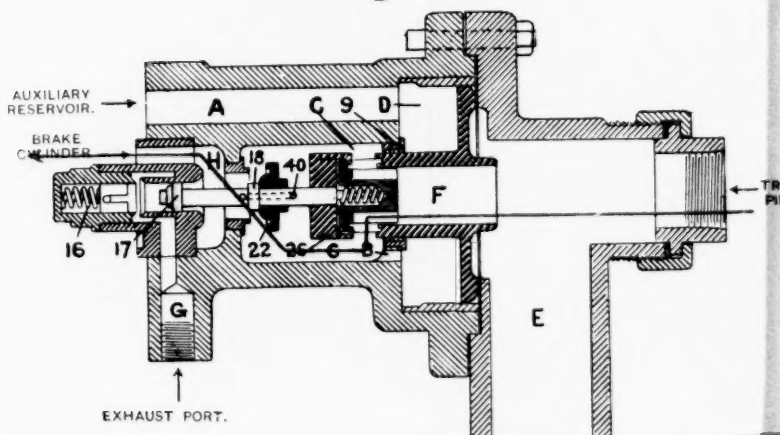


The course of the air from the Train Pipe to the Brake Cylinder is through the Auxiliary Valve and by-pass, colored Red, and is shown by a Blue line while the air passing from the Auxiliary Reservoir to the Brake Cylinder through Main Valve, Black, of the Triple Valve, is shown by a Yellow line. Thus in the complainants structure two machines are required to perform the two functions.

Defendants Structure.

With the Valves in the Quick-Action Position.

Fig. 2.

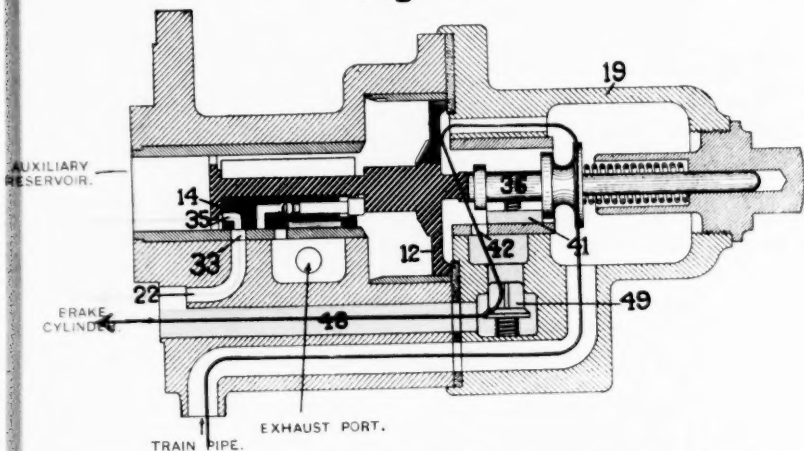


By a blue line, while the air passing from the Auxiliary Reservoir to the Brake Cylinder through the Main Valve of the Triple Valve, is shown by a Yellow line. Thus in the Defendants Structure only one machine is required to perform the two functions.

Complainants Structure of Patent 360,070

With the Valves in the Quick-Action Position.

Fig. 1.

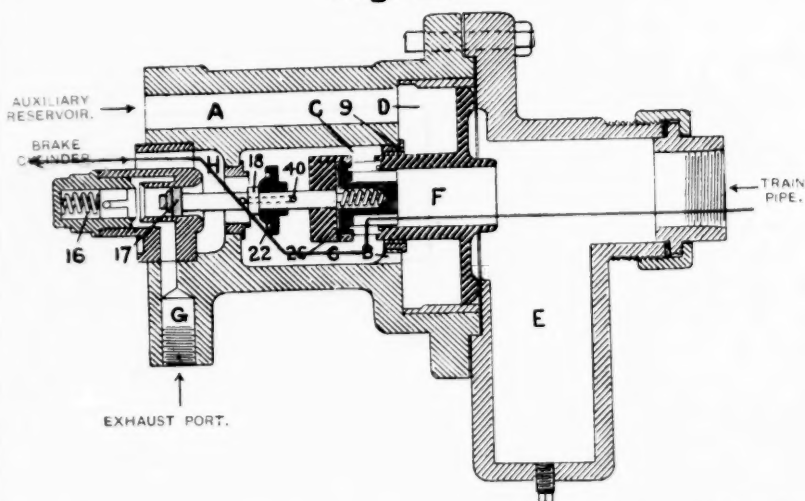


The course of the air from the Train Pipe to the Brake Cylinder is through the port opened by the Auxiliary Valve and by-passage, colored Red, and is shown by a Blue line, while the air passing from the Auxiliary Reservoir to the Brake Cylinder through the Main Valve, Black, of the Triple Valve, is shown by a Yellow line. Thus in the complainants structure two machines are required to perform the two functions.

Defendants Structure.

With the Valves in the Quick-Action Position.

Fig. 2.



The course of the air from the Train Pipe to the Brake Cylinder is through the Trip Valve Chamber C and port opened by the Main Valve 22, Black, of the Triple Valve, and

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triple-valve chamber C, thence through the port uncovered by the main-valve 22 to the brake-cylinder. The air from the auxiliary-reservoir (shown by a yellow line) passes through the passage B, into said valve chamber C, then through the *same* port (uncovered by the main-valve 22) through which the air from the train-pipe is passing, to the brake cylinder, thereby retaining the old main-valve to admit the auxiliary-reservoir air and *causing the same valve* to admit the train-pipe air.

It will be seen from the foregoing that *one valve*, the old main-valve 22 of Defendants' triple-valve, admits *two airs* to the brake-cylinder when applying the brakes for quick applications, instead of *two valves*, the main-valve port 35 and auxiliary-valve 41 as used by Complainant, to admit the *two airs*.

The foregoing comparison of Complainants' and Defendants' devices shows that, while both obtain the same *result* of quick-action, the *means* and mode of operation by which they obtain that result are *totally dissimilar* having absolutely nothing in common. The quick-action *means* of the one is necessarily an auxiliary-valve device whereby train-pipe air may pass direct to the brake-cylinder independent of the triple-valves and "additional" to them, as Mr. Westinghouse correctly states in his patent, and as Mr. H. H. Westinghouse testified at the bottom of p. 124 of the transcript; the quick-action means of the other is a *mere modification* of the triple-valve structure *itself*, consisting of the immovable partition 9 and properly proportioning the original passages, whereby train-pipe air may pass direct to the brake-cylinder through the triple-valves.

It is therefore obvious that the Defendants' structure is totally destitute of the means described and claimed in the patent in suit to admit the train-pipe air to the brake-cylinder.

Mr. Boyden, in making up his triple-valve, used only the old triple-valve elements well known prior to 1886, to wit: The feed-valve of patents 144,006 and 280,285, the main-valve and release-valve of patent 141,685, and the graduating-valve of patent 220,556; and that his triple-valve structure comes squarely under the definition of "triple-valve" as given by Mr. Westinghouse in the specification of the patent in suit, where he says (p. 468):

"In using the terms 'triple-valve' and 'triple-valve device,' I refer to a valve device, *however specifically*

“constructed, having a connection with the main air or
 “brake-pipe, another with an auxiliary-reservoir or
 “chamber for the storage of power, and another with a
 “brake-cylinder or its equivalent for the utilization of
 “the stored power and with a release or discharge pas-
 “sage for releasing the operative power from the brake-
 “cylinder, whether valves governing these passages or
 “connections are arranged in one or more cases and are
 “moved by a piston or its equivalent or by a series of
 “pistons or their equivalents, there being numerous
 “examples in the art of constructions varying materially
 “in appearance whereby these functions are performed,
 “both in plenum and vacuum brake-mechanisms.”

It follows that the Complainants' contention that Boyden's main-valve 22 is an auxiliary-valve, in the sense of patent 360,070, is totally unsound. It is no such thing. Like his feed-valve, his release-valve, and his graduating-valve, it is simply one of the old parts of the old wellknown triple-valve, performing the same old function that it always performed before.

Whenever, in the operation of an automatic air-brake, a valve admits auxiliary-reservoir air to the brake-cylinder, that valve is an essential part of the old triple-valve known in the art long prior to the patent in suit; and it is not the auxiliary-valve 41 of patent 360,070, which does not and cannot perform any such function.

Boyden simply uses the old triple-valve, defined by Mr. Westinghouse as well known in the prior art; and he enables it, as Judge Morris correctly holds (p. 845):

“By an ingenious arrangement restricting the admis-
 “sion of auxiliary-reservoir air to the triple-valve cham-
 “ber, to cause the main-valve to do *both* main-valve
 “work when needed, and to do quick action work when
 “needed.”

THE TWO DECISIONS BELOW.

Judge Morris committed the legal error of holding that claim 2 of patent 360,070 is entitled to cover functional equivalents (p. 846). He evidently based this judgment upon the mistaken idea that patent 360,070 was the first to show a triple-valve piston having, for emergency-stop purposes, a further

traverse than for graduating purposes. He speaks of the "further traverse" as something "unusual" in air-brakes (p. 843); although, as the evidence shows, it is found in triple-valves from the original patent, No. 141,685, to the present time. Indeed, if a triple-valve be capable of venting auxiliary-reservoir air to the brake-cylinder slowly for graduation and quickly for emergencies, there is no other conceivable way in which it can be done than by giving the piston two ranges of traverse, so that it can partially open the main port for the one purpose and fully open it for the other.

His assumption of fact being wrong, the conclusion of law based thereon, of course, falls to the ground.

But if his assumption of fact had been correct, his legal conclusion from such fact would still be wrong, for the following reasons:

First, The *piston*, in its "further traverse," does not *itself* admit train-pipe air to the brake-cylinder; it simply sets in action certain *means* which admit such air, namely, the auxiliary-valve 41 and its by-passage. The specification, by the words "substantially as set forth," makes these means a part of the claim (Seymour vs. Osborne, 11 Wall., 516, 547; Miller vs. Eagle Manufacturing Co., 151 U. S., 186, 202). Indeed, they would have to be read into the claim even in the absence of such words (Mitchell vs. Tilghman, 19 Wall., 391). The claim must always be limited to the means by which the result is effected, and if not so limited in terms or by legal construction it is void. (O'Reilly vs. Morse, 15 How., 62, 119.)

Second, The *specification* of this patent expressly limits the claim to the means by stating that the only invention "claimed" consists in the "*structural features*" (p. 784, line 13) by which the direct admission of train-pipe air to the brake-cylinder is effected, and states that these structural features are composed of the additional valve 41 and its by-passage.

Third, The admissions and erasures made during the prosecution of the application in the Patent Office conclusively limit all the claims to "an auxiliary-valve" (p. 718), and prevent the claims from being construed to cover "a valve integral with the main-valve" for admitting train-pipe air to the brake-cylinder (p. 714).

Fourth, Complainants' counsel, on pp. 40-41 of their brief used in the Circuit Court of Appeals, admit that the "*quick-action attachment* consisting of an air conduit or passage-way directly from the train-pipe connection to the brake-cylinder, and a valve to control it, * * * *is so made the subject matter of every claim in controversy as to give character and effect thereto.*"

We respectfully submit, in view of the authorities above cited and the repeated admissions above referred to, that, whether the "further traverse" were new or old, Judge Morris' construction of claim 2 cannot be sustained.

It is evident from his opinion that Judge Morris has an erroneous conception of the law relating to pioneer inventions, believing that, in some cases, patents for such inventions can be infringed by the use of *functional* equivalents, in the absence of anything like a mechanical equivalent.

This Court has always held the contrary: and the law is so well settled by its repeated decisions that it is difficult to see how anybody can misunderstand it. The very authorities cited by Judge Morris on pages 847, 848 in support of his position are directly against it; and there are many other decisions of this Court on the subject, so clear that misunderstanding would seem impossible. Morse's telegraph was, in the highest sense of the word, a pioneer invention; but, in deciding upon his patent, in *O'Reilly vs. Morse*, 15 How., 62, 119, this Court said:

"Whoever discovers that a certain useful result will be
 "produced, in any art, machine, manufacture, or com-
 "position of matter, by the use of certain means, is
 "entitled to a patent for it; provided he specifies the
 "means he uses in a manner so full and exact that any
 "one skilled in the science to which it appertains can,
 "by using the means he specifies, without any addition
 "to, or subtraction from them, produce precisely the
 "result he describes. And if this cannot be done by the
 "means he describes, the patent is void. And if it can
 "be done, then the patent confers on him the exclusive
 "right to use the means he specifies to produce the result
 "or effect he describes, and nothing more. And it makes
 "no difference, in this respect, whether the effect is pro-
 "duced by chemical agency or combination; or by the

"application of discoveries or principles in natural philosophy known or unknown before his invention; or by machinery acting altogether upon mechanical principles. In either case, he must describe the manner and process as above mentioned, and the end it accomplishes. Any one may lawfully accomplish the same end without infringing the patent, if he uses *means* substantially different from those described."

And the Court held Morse's eighth claim to be void, because it did not specify the means by which the described result was accomplished.

In the recent case of *Miller vs. Eagle Mfg. Co.*, 151 U. S., 186, 201, this Court said:

"It is not the result, effect, or purpose to be accomplished which constitutes invention, or entitles a party to a patent, but the *mechanical means* or instrumentalities by which the object sought is to be attained. . . . Patents cover the means employed to effect results."

See also 2 Robinson on Patents, Sec. 518.

Rosseau vs. Peck, 66 F. R., 759.

Wicke vs. Ostrum, 103 U. S., 461, 469.

Electric Signal Co. vs. Hall Signal Co., 114 U. S., 87.

White vs. Dunbar, 119 U. S., 47.

Wollensak vs. Sargeant, 151 U. S., 221.

Knapp vs. Morse, 150 U. S., 221.

Burr vs. Duryea, 1 Wall., 531.

In citing *McCormick vs. Talcott*, *Machine Co. vs. Murphy*, *Valve Co. vs. Valve Co.*, and *Morley vs. Lancaster*, in support of his position on this question, Judge Morris overlooked the fact that this Court, in all those pioneer cases, expressly emphasized the *means as vital* to the question of infringement. Its language is—

"Operating on the same principle and performing the same functions by analogous *means*" (*McCormick vs. Talcott*, p. 405); "at the result, as well as at the *means* by which the result is attained" (*Machine Co. vs. Murphy*, p. 125); "in the Defendant's valve Complaints' exhibit A, the same effects in operation are produced as in the Richardson valve, by the *means* described in Richardson's claim" (*Valve Co. vs. Valve*

"Co., p. 177); "all subsequent machines which employ substantially the same *means* to accomplish the same results are infringements" (Morley vs. Lancaster, p. 273.)

The true rule is that laid down by this court, in Miller vs. Eagle Mfg. Co., 151 U. S., page 207, in the following words:

"The range of equivalents depends upon the extent and nature of the invention. If the invention is broad in its character, the range of equivalents will be correspondingly broad, under the liberal construction which the courts give to such inventions. The doctrine was well stated in Morley Machine Co., vs. Lancaster, 129 U. S., 263, 273, where it is said: 'Where an invention is one of a primary character and the mechanical functions performed by the machine are, as a whole, entirely new, all subsequent machines which employ *substantially the same means* to accomplish the same result are infringements, although the subsequent machine may contain improvements in the separate mechanisms which go to make up the machine.'

Tested by this rule, the patent in suit 360,070 was pioneer *as to the auxiliary-valve 41 and its by-passage*, covering them and their mechanical equivalents, in whatever form they may be used. Westinghouse invented what the Complainants' counsel and the Circuit Court of Appeals for the Fourth Circuit call his "new machine," which he combined with the old triple-valve machine, making two machines combined in one structure; and his range of equivalents is confined to combinations containing his new machine combined with the old well-known machine. If that combination exist in the alleged infringing device, then infringement is established, even though the form of the "new machine" element may be considerably varied from that shown in his patent. But the "new machine" element must be present, in some form or other, or else there is no infringement.

In the New York case, Judge Lacombe properly held the New York Air-Brake Co. guilty of infringement because it used the new machine, the auxiliary-valve 41 and its by-passage, and only varied their form. (See N. Y. device, p. 34, this Brief).

Here, however, the Defendants use the main-valve of the

old triple-valve machine to accomplish the same result *without the presence of the new machine* of the patent in any form whatever; and no court has ever found infringement under such circumstances. To do so would be to discard the whole doctrine of mechanical equivalents and hold that a man can patent results or effects, without regard to the means employed for accomplishing them.

The Circuit Court of Appeals for the Fourth Circuit was right, both as to the facts and the law—*holding*, that the further traverse of the piston was old and usual in triple-valves like those of patent 220,556 (pp. 872, 879, 880); that the Boyden valve 22 is the main-valve of his triple valve, and is not the Westinghouse valve 41 (pp. 881–882); that patents cover only the *means*, or their mechanical equivalents for producing the result, and not the result itself (p. 882); that Boyden's quick-action device is not the mechanical equivalent of that of Westinghouse, but "they * * * differ as widely from each other as two devices for accomplishing the same result can well differ," (p. 880); that prior to the patent in suit Westinghouse had already, in patent 217,838, disclosed the principle of quickening the serial or successive application of the brakes on the several cars by venting the train-pipe at each car (p. 872); that the Court's duty to the public and to inventors at large forbids it to restore to the claim of Westinghouse the matters *which he had erased or virtually disclaimed* at the Patent Office (p. 881), and that the Defendants' device infringes none of the claims of patent 360,070 when the latter are properly construed.

We submit that the conclusion arrived at by the Circuit Court of Appeals is simply impregnable.

We call attention to the fact that Judge Morris and the Circuit Court of Appeals entirely agree on the following points, to wit: That the Boyden valve 22 is the main-valve and not the auxiliary-valve 41 or its mechanical equivalent, and that Boyden accomplishes "quick-action" not by an auxiliary-valve and by-passage, but (p. 845) "by an ingenious arrangement restricting the admission of auxiliary-reservoir air to the triple-valve chamber;" that is to say, by the "partition 9" and the proper proportioning of the old air-passages.

THE DEFENDANTS' DEVICE BROADLY PATENTED TO BOYDEN.

Another consideration of great weight remains to be noticed. The Defendants' device was broadly patented to Mr. Boyden August 16, 1892, *not as an improvement on the Westinghouse device*, but as a new and different means for accomplishing the same result, *operating on a new principle and by a new and different mode of operation*. In the specification of this patent No. 481,134 (applied for September 30, 1889, before this suit was brought), the patent says (p. 1307):

"Efforts have heretofore been made to combine with a
"triple-valve certain *additional* mechanism by which
"train-pipe air could be introduced directly into the
"brake-cylinder in effecting the application of the brakes
"for emergency stops; but in every such instance a sup-
"plemental passage or passages, together with a supple-
"mentary or auxiliary-valve, has had to be employed in
"connection with the triple-valve proper, in order that
"the ordinary functions of the triple-valve might be pre-
"served and the additional function of introducing train-
"pipe air into the brake-cylinder for emergency stops
"might be combined therewith.

"An example of the class of valves referred to in the
"last preceding paragraph *which employ an auxiliary-*
"*valve*, combined with an ordinary triple-valve, is shown
"in United States Patent, to George Westinghouse, Jr.
"dated March 29, 1887, No. 360,070.

"It will be seen that my present invention for intro-
"ducing train-pipe air into the brake-cylinder for emer-
"gency stops *differs essentially* from the device shown in
"the said patent No. 360,070, because I have provided a
"*new principle* of construction and a *new mode* of opera-
"tion, by use of which the desired result aforesaid may
"be produced *without the aid of the auxiliary-valve*
"*heretofore required for the purpose*.

"An examination of the particular embodiment of the
"present invention will disclose the fact that it is a
"triple-valve *per se*, without auxiliary or supplemental
"valve devices, and, further, that its conversion into a
"quick-action valve and its greater capacity for action

“over ordinary forms of triple valves *is due to means which I have invented for retarding or restricting the flow of auxiliary-reservoir air to the main port or passage leading to the brake-cylinder as compared with the more open or free delivery of train-pipe air to the said main port or passage.* * * * And, further, *a single valve—the main valve of the triple-valve proper—is here made to perform the office of opening communication to the brake-cylinder from both the train-pipe and the auxiliary-reservoir in the quick application of the brakes for emergency stops. My invention, therefore, includes any form or structure of valve wherein a single valve admits both train-pipe air and auxiliary-reservoir air to the brake-cylinder in applying for emergency stops, and which structure is provided with means for restricting or retarding the flow of auxiliary-reservoir air to the brake-cylinder as compared with the flow of the train-pipe air thereto.*”

The experienced experts of the Patent Office recognized these statements to be true; and the Commissioner of Patents officially endorsed them as true by granting the patent which contains them, with broad generic claims for Mr. Boyden's new quick-action device—thus adjudicating its entire independence of the Westinghouse device, and holding it to be for a different principle and mode of operation. This action officially puts the Westinghouse patent and the Boyden patent on the same plane with respect to originality and novelty, and in totally different categories as respects the nature of their inventions.

This Court has repeatedly held that such a patent, granted to the later inventor, not as an improvement upon the device of the earlier inventor, but as a new and different way of accomplishing the same result, is evidence of novelty and of non-infringement.

“Consequently such a patent may be, and generally is, received as *prima facie* evidence of the truth of the facts asserted in it. And in cases where the evidence is nicely balanced, it may have weight with a jury in making up their decision as to the Plaintiff's right; and if so, it is not easy to perceive why the Defendant who uses a patented machine should not have the benefit of a like presumption in his favor, arising from a like

"investigation of the originality of his invention, and
 "the judgment of the public officers, that his machine
 "new, and not an infringement of the patent previously
 "granted to the Plaintiff. * * * * The parties should
 "contend on an equal field, and be allowed to use the
 "same weapons.

"The judgment of the Circuit Court is, therefore, reversed,
 "and a *venire de novo* awarded."

Corning vs. Burden, 15 How., 251, 271.

See also, Miller vs. Eagle Mfg. Co., 151 U. S., 186, 200.

Boyd vs. Tool Co., 15 Sup. Ct. Reporter, 837.

Pavement Co. vs. Elizabeth, 4 Fisher, 189.

Ransome vs. Hyatt, 69 Fed. Rep., 148, 149.

3 Robinson on Pats., p. 243, Sec. 1016.

CONCLUSION.

In view of the matters herein referred to, we do not see
 how it is possible for any court to reach the conclusion that
 the Defendants' device infringes any claim of the patent in
 suit.

We do not desire in any way to belittle the invention of Mr.
 Westinghouse. While it did not solve the problem of preventing
 "shocks," it did contribute to the art a new and important
 factor which proved to be indispensable to the successful formation
 of quick-action device subsequently invented by Mr. Westinghouse.
 We entirely agree with Judge Lacombe (16 C. C. 371) and the Circuit
 Court of Appeals of the Second Circuit that the devices of patents
 360,070 and 376,837—one the auxiliary-valve and the other the
 supplemental piston—appear to be both essential to the structure
 of a quick-action air-brake embodying the Westinghouse principle
 or mode of operation.

For the purpose of the argument on the question of infringement
 we, therefore, concede the validity of patent 360,070 and the
 importance and value of the invention which it describes.

But there are two different and independent ways of producing quick-action—The one, by adding to the old triple-valve a new auxiliary-valve and by-passage; the other, by peculiarly differentiating the air pressures which bear upon the old triple-valve. Mr. Westinghouse has broadly patented the former, and Mr. Boyden the latter. There is nothing in common between these two ways of accomplishing the result except the old triple-valve, and that is not patentable to either party.

The invention of Mr. Westinghouse just as clearly excludes the Boyden idea, as the invention of Mr. Boyden excludes the idea of Mr. Westinghouse. The patents of Mr. Westinghouse and Mr. Boyden are *both* generic, primary, or pioneer patents each in its own way, and there is no conflict between them. Together, they cover the whole field; separately, each leaves half of the field unoccupied.

Respectfully submitted,

LYSANDER HILL,

Counsel for Defendants.

NOTE.—The attention of the Court is called to a supplemental Brief, by associate counsel, in behalf of Defendants.

17-503 4-26
Supreme Court of the United States.

October Term, 1896. Nos. 403 and 426.

Filed Oct. 22, 1896.

BOYDEN POWER BRAKE COMPANY.

GEORGE A. BOYDEN, President.
CHARLES B. MANN, Secretary.
WILLIAM WHITRIDGE, Treasurer.

AND

BOYDEN BRAKE COMPANY,

Appellants.

APPEAL.

VS.

GEORGE WESTINGHOUSE, JR.

AND

THE WESTINGHOUSE AIR-BRAKE CO.

Appellees.

GEORGE WESTINGHOUSE, JR.

AND

THE WESTINGHOUSE AIR-BRAKE CO.

Appellants.

VS.

BOYDEN POWER BRAKE COMPANY.

GEORGE A. BOYDEN, President.
CHARLES B. MANN, Secretary.
WILLIAM WHITRIDGE, Treasurer.

AND

BOYDEN BRAKE COMPANY,

Appellees.

CROSS-APPEAL.

ADDITIONAL BRIEF OF ARGUMENT,
FOR BOYDEN BRAKE CO.

HECTOR T. FENTON,
Of Counsel for the Boyden Brake Co.

Supreme Court of the United States.

October Term, 1896. Nos. 403 and 426.

BOYDEN BRAKE Co., <i>et al.</i> ,	}	<i>Appellants,</i>
vs.		
THE WESTINGHOUSE AIR-BRAKE Co., <i>et al.</i> ,	}	<i>Appellees.</i>

Appeal.

THE WESTINGHOUSE AIR-BRAKE Co., <i>et al.</i> ,	}	<i>Appellants,</i>
vs.		
BOYDEN BRAKE Co., <i>et al.</i> ,	}	<i>Appellees.</i>

Cross-Appeal.

ARGUMENT FOR THE BOYDEN BRAKE CO.

Notwithstanding the presumption, arising from the voluminous character of the record, that the questions involved are complex, difficult and unusual; and from the inaccurate and misleading allegations in the Westinghouse Company's petition for the writ of *certiorari*, that the decision of the Court of Appeals in the Fourth Circuit, on these appeals, conflicts with a prior decision of the Appellate Court in the Second Circuit, on the same question, we confidently submit, and shall endeavor to clearly demonstrate, by a comparative examination of the opinions of the appellate tribunals in the Second and Fourth Circuits respectively, and by a concise statement of the controlling

facts governing the decision in the case at bar, that not only is there no conflict nor even a semblance of a conflict between the decisions of the appellate tribunals in the two circuits, on any question adjudicated by either, but in the case at bar there was a single issue involved, *i. e.*, infringement, which was dependent for its solution solely upon whether or not the respective machines of the plaintiff and defendant were alike in principle of construction and operation, or were radically different *quoad* the matters described and claimed as new in the plaintiff's patent in suit. In other words, the questions involved in the case were of the simplest character, the single issue being an issue of fact, *i. e.*, the identity or non-identity of the two machines. True, the determination of this issue of fact is dependent upon the construction to be given to the claim, but that is so in every case.

There was no effort made or argument advanced by the Boyden Brake Co. in the Court of Appeals to dispute, qualify or limit the scope or effect of the decisions in the Second Circuit as *res judicata* on the construction of the claims, but, on the contrary, we relied upon and urged upon the Appellate Court in the Fourth Circuit that the construction and interpretation of the plaintiff's patent, and especially of claim 2 thereof, by Judge Lacombe (65 Fed. Rep. 99, affirmed on appeal), was correct, and that, if accepted as correct and followed by the Court of Appeals in the Fourth Circuit, it required that the latter tribunal should reverse the decree entered by the Circuit Court in the case at bar, which construed the claim 2 aforesaid very differently and inconsistently with the construction given to it in the Second Circuit.

It is proposed in this brief to consider:

I. What was decided in the second and fourth circuits respectively, to determine whether or not there is any conflict between them on the same question.

II. Whether or not there was any error, either of fact or of law, in the decision sought to be reviewed, that in any manner affected or controlled the result,

Before presenting a brief argument on these general questions, it will conduce to a better understanding of the case, if special attention is called to a few leading facts. The bill alleged the grant of a patent to Westinghouse No. 360,070, dated March 29, 1887, and averred that defendant had made and sold air-brakes embodying mechanism that infringed claims, 1, 2 and 4 of said patent; the defense to which was that the machines of the respective parties differed radically from each other, and were in all essential particulars so dissimilar that it was obvious that there was no infringement of claims 1 and 4, and none of claim 2 if the latter was properly construed. The peculiar phraseology of that single claim gave rise to the only really debatable or disputable question in the case.

After hearing on pleadings and proofs, the Circuit Court dismissed the bill as respects claims 1 and 4 on its finding of *fact* that the defendants' device did not contain the mechanisms expressly referred to in said claims and hence did not infringe such claims, but it adjudged in favor of the plaintiffs as respects claim 2 on the theory that although the devices were not structurally the same, but widely different in means employed, they were *functionally* identical; in other words, the learned Judge (Morris, J.) found, as clearly stated in his opinion, that although the Westinghouse *invention* described in the body of the specification was necessarily inclusive of certain characteristic elements, which he did *not* find in the defendants' device either in the same or in any substantially similar or equivalent form, yet (the Court said) the claim was not *in terms* restricted to means, but referred only to the *function* performed, hence he held that it was proper to compare the devices (and he did so compare them) by their functions or results and not by their respective means employed to perform these functions and produce these results. (Hence the remarks found in the opinion of the Court of Appeals on the invalidity of functional claims.) This ruling by the Circuit Court was so obviously contrary to settled doctrine, and erroneous, that defendants appealed from the decision adjudging them to have infringed said 2nd claim; to offset which plaintiffs prayed a cross-appeal for the refusal to sustain their bill as to claims 1 and 4.

Sufficient appears from a comparative reading of the decisions of the Circuit Court and of the Circuit Court of Appeals, in the case at bar, aided by a reference to the colored diagrams annexed to the opinion of the Circuit Court of Appeals, to show conclusively that *both* courts decided that the defendants' device was not only structurally different from, but was not the same in principle of construction and operation, as the Westinghouse patented device; in that the former contained no auxiliary-valve device independent of the main triple valve nor the necessary adjunct in such device of a separate and direct passage way from the train-pipe to the brake-cylinder; hence (as these elements were expressed in the 1st and 4th claims) there was obviously no infringement of those claims. Both courts were in perfect accord on this finding of fact, and the Plaintiff has utterly failed to point out any error in such finding; neither has it been able to point out any error in the finding of either court as to what constitutes the invention disclosed in the Westinghouse patent, even assuming it to be a pioneer patent and entitled to the broadest possible construction. The sole material difference of opinion between the Circuit Court and the Circuit Court of Appeals, and because of which the former was reversed, was in that the former construed the 2d claim more broadly than was warranted by its finding of what constituted the invention disclosed in the body of the specification; and hence was necessarily compelled to compare the devices of the parties litigant by their functions and not by the mechanical means employed, because it found as a fact that such mechanical means were widely different. No one can read the opinion of the Circuit Court without being impressed with the belief that had it not erroneously construed said 2d claim, but had construed it to be broadly for means auxiliary to and independent of the main-valve of the triple-valve, actuated "by the (usual) further traverse of the piston" of the triple-valve, (as the *invention* is defined in the patent, as it is defined in the opinion of the Circuit Court of Appeals, complained of, and as it is defined in the opinion of Judge Lacombe in the Second Circuit, 65 Fed. Rep. 99), the Circuit Court for the District of Maryland would have held *as a fact* that the defendants' device in the case at bar did not involve such invention or its elements or anything substantially equivalent thereto, and hence did not infringe said *second* claim.

It will lighten the labor of investigation by this Court if we refer to the petition for the writ of certiorari, filed by the Westinghouse Company, to ascertain in what particulars they deem the decision of the Court of Appeals to be erroneous.

Their allegations are: That there was a prior adjudication in the Second Circuit (65 Fed. Rep., 99), in which claim 2 of this patent was adjudged to be valid. That in the case at bar the Circuit Court of Appeals for the Fourth Circuit "has adjudged and declared that said second claim is invalid and does not cover subject matter which can be lawfully claimed;" and hence, that there is a conflict of decision on the same question.

It is respectfully submitted that the Court of Appeals has not so decided, and that the decision has evidently been misunderstood or misinterpreted by the petitioners; the adjudication being in effect that if claim 2 is to be construed (as the Circuit Court held and applied it) for a function or result irrespective of the means employed to perform such function or produce such result, it is "fatally defective," but the following paragraphs of the opinion clearly show that the Court construed it by implying the means, by force of the concluding words, "substantially as described;" and, hence, reversing the Circuit Court on its finding of law, in the construction of the claim, affirmed it on its finding of fact that the plaintiffs' machine as so defined, was neither the same as, nor substantially similar to, the defendant's machine either in principle of construction or in mode of operation. In the petition it is said—paragraph 13—that said second claim is of great value and importance. A reference to Judge Lacombe's opinion in the Second Circuit (65 Fed. Rep., 99) will show that it is of comparatively minor importance, and merely inclusive of a modified form of the device covered by the first and principal claim.

It is said in the petition page 6, that "the invention of the patent in suit, No. 360,070, is one which is used on upwards of 400,000 freight cars at the present time," etc. As this paragraph was evidently inserted for the purpose of impressing this Court with the belief that the subject matter of this litigation was of sufficient value and importance to warrant this Court in reviewing it on that ground alone, it is proper to reply to said statement by the remark that the same is wholly incorrect and misleading. What the petitioners meant to say or ought to have

said, is that the device of the later patent, No. 376,837, referred to in the 9th and 10th paragraphs of the petition (which said patent is for an operative and highly useful and successful improved quick-action brake embodying some of the features and principles of their earlier patent, No. 360,070,) is so "used on upwards of 400,000 freight cars at the present time," because it was proven in the case in the 2d Circuit and also in the present case in the 4th Circuit, that the device of the patent here in question is not now made by the petitioners and has not been made or sold by them since 1887 when they adopted the device of the later patent, No. 376,837, as their standard form. The defendants alleged that the manufacture and sale of No. 360,070 was abandoned by the petitioners because of its radical defects; on the other hand the petitioners allege that it is not defective, but that the later device is better for their purpose. We leave the Court to draw its own conclusion on this point; (which, however, is not material in the present inquiry) from the remarks of Judges Townsend and Shipman on that question (65 Fed. Rep. 99 and 69 Fed. Rep. 715) and Record, page 149, Ans. to X-Qs. 163 to 167.

These two New York cases are also instructive in showing what view the court and the plaintiffs in those cases entertained and enforced as to the utility and scope of the invention of patent 360,070, which was *not* in suit therein, but was set up by the defendants therein as anticipating and qualifying the later patent—376,837—on which said case was founded. After the decisions in said case the plaintiffs brought a suit on both patents, including 360,070, the opinion in which, on motion for preliminary injunction, was written by Judge Lacombe and is reported—65 Fed. Rep., 99. That case was founded on both patents, Nos. 360,070, March 28, 1887, and 376,837 dated January 24, 1888.

It is to be noted that of these patents, the second one, No. 376,837, is the *only* one that had *then* been favorably adjudicated.

Each of the aforesaid patents are for "auxiliary-valves" *additional* to the triple-valve, and operating to open *independent* ports and *passage-ways* leading directly to the brake-cylinder. In 360,070 the auxiliary-valve is opened by means of the triple-valve piston acting *mechanically* on it (as both the

New York courts said of it.) In 376,837 the auxiliary-valve is opened by auxiliary-reservoir air pressure acting on a supplemental piston, and not mechanically by the triple-valve piston. (See Rec., page 153, X-Q. and Ans. 182.)

It will be seen that in both of these Westinghouse patents train-pipe air is admitted to the brake-cylinder through an *independent* passage controlled by an "auxiliary-valve" *additional* to the "triple-valve"—the difference between these patents is merely that each has its own specific means to open the said "auxiliary valve."

In order to a proper understanding of exactly what the decision complained of determines as adjudicated matters of law and fact, we may best reach a correct conclusion by inquiring (a) what in general terms is the invention patented; (b) what in general terms is the device of the defendant alleged to infringe; (c) why the Circuit Court, as well as the Court of Appeals, held that the latter was not substantially similar to the former in respect of the matter of claims 1 and 4 as to which the bill was dismissed in the first instance; (d) what construction of claim 2 was proper and allowable under the broadest interpretation that could be given to it in view of the descriptive matter in the specification and the file and contents of the application; (e) that the construction so given to it was entirely consistent with, and, indeed, exactly the same as given to it by the courts in the Second Circuit; and (f) that, although under the *same* construction of claim 2 by the appellate tribunals in the Second and Fourth Circuits, respectively, the device of one defendant was adjudged to infringe, while the device of the other was held not to infringe, this result was not due to any conflict or contrariety of decision between the two courts *as to the proper interpretation of the claim*, but was due solely to the fact that the respective devices of the two defendants were totally different from each other, in that while the Boyden Brake Co.'s device did not contain the invention of the second or any other claim of the Westinghouse patent, as the said claims were defined by either the Courts of Appeals in the Second or the Fourth Circuit, the device of the defendant in the Second Circuit *did* contain the invention as so defined in *all* the claims. Hence, the alleged variance is not a conflict of decisions, as to a question of law or the construction of the claim, but a difference of finding,

and a proper difference of finding, of *fact*, on the issue of infringement only in the two cases, respectively; and necessarily so because in the one case the Westinghouse invention was compared with a device substantially identical with it, while in the other case it was compared (under the same interpretation of the claims) with a device which was totally different from it.

And this difference between the devices of the respective defendants in the two cases will be apparent at once on a comparison of the colored diagrams of the said devices annexed to the opinion complained of, in connection with the opinion of the Circuit Court and the Circuit Court of Appeals for the Fourth Circuit defining the Boyden Brake Co.'s device (Proceedings, page 877), and of the Circuit Court (Lacombe, J.) defining the New York Air Brake Co.'s device (opposite page 883).

A BRIEF COMPARATIVE EXAMINATION OF THE PLAINTIFF'S AND DEFENDANTS' MACHINES.

The marked differences in principle of construction and operation between the Plaintiffs' and Defendants' machines respectively, should be clearly understood, and when so understood the propriety and correctness of the decision of the Circuit Court of Appeals for the Fourth Circuit will be apparent at once.

COMPLAINANT'S MACHINE.

By reference to the Plaintiffs' patent, and to the several decisions explaining and defining the invention, both in the Second and Fourth Circuits (which are entirely in accord on this subject), we find that it consists of a brake device, having for its foundation or principal element in the new combination, a triple-valve device such as is described in the old and expired Westinghouse patent No. 220,556. This device operated to admit air pressure to the brake-cylinder solely from the auxiliary-reservoir. To this device, as so constructed and operated, AND WITHOUT CHANGE THEREIN, EITHER IN ITS PARTS OR IN THE MODE OF OPERATION OF ITS PARTS, or in any of the triple-valve functions performed thereby, the patentee of 360,070 (the patent in suit) *added* two elements, viz., an auxiliary-valve (marked 41) and a passageway (marked 46) controlled thereby. This valve 41 was purely *auxiliary*, both in mechanical construction and mechanical operation; hence (as stated in the patent) it was *independ-*

ent of the main valve, and could be plugged up without in any manner affecting the action of the triple-valve, or any of its parts or passages. This valve 41 and passage 46 are shown in the red coloring on the diagram (proceeding page 877) annexed to the opinion of Judge Hughes in the Court of Appeals, and are thus brought out clearly so as to be sufficiently understood. Indeed, so distinct and segregable are the new *added* parts from the old triple valve parts of patent 220,556 that the Counsel for petitioners, in their briefs in the Circuit and Appellate Courts, described the new device as *two* machines enclosed in one case or box, the new part (or machine) being brought into action by the old under certain conditions.

The exact language of the statements referred to, in the Westinghouse brief, is as follows :

"Westinghouse added to and combined with the brake
 "(the automatic brake of the prior patents, Nos. 220,556)
 "another brake mechanism. * * * And he so com-
 "bined these two mechanisms, "the service" and the
 "quick-action," that while, in fact, they constitute *two*
 "*machines*, they are also included in a *single structure*.
 "(The italics are in the original.)"

And again :

"Thus it will be seen that this quick-action attach-
 "ment, *consisting of an air conduit or passage-way*
 "*directly from the train-pipe connection to the brake-*
 "*cylinder, and a valve to control it*, such valve itself be-
 "ing under control of the triple-piston and so combined
 "with the old automatic brake appliances that not inter-
 "fering with the ordinary use of the latter it, the quick-
 "action attachment, may be used as an auxiliary emer-
 "gency device in the presence of great or serious danger—
 "that *this*, the chief novelty and element of utility of
 "the Westinghouse invention now in controversy is so
 "made the subject of *every claim in controversy* as to
 "give character and effect thereto, etc. (The italics are
 "*not* in the original.)"

The counsel, in the foregoing statements, undoubtedly made a correct exposition, both as to the character of the apparatus patented by Westinghouse and the scope of the claims therefor. We do not dispute either proposition, because it accords exactly with the patentees statement contained in the Patent, in which after elaborately describing the prior automatic brake (of patents 220,556 and others), he says :

"So far as hereinbefore described, the triple-valve "accords in all substantial particulars with, and is "adapted to operate similarly to those of my letters "patent Nos. 168,359, 172,064 and 220,556, and in order "that it may perform the further functions requisite in "the practice of my present invention, it is provided with "certain *additional members*."

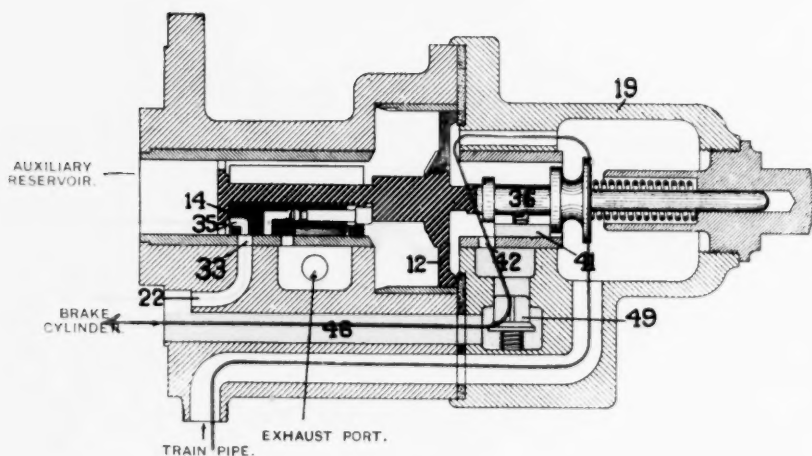
He then proceeds to tell us in plain English words that do not admit of doubtful meaning, that these *additional members*, consist of "an auxiliary-valve, 41 (which) is connected to and moves with the stem, 36, said valve working over a face on the bushing, 37, between the piston chamber, 11, and drain cup 19 and governing a port, 42, in said face leading into a chamber, 43, adjoining the same."

Opposite is a diagram of the patented device, taken from the patent drawing, the new parts being colored in red to show quickly to the eye exactly what are the "additional members" and what is the relation they bear to the old parts—the triple-valve proper. In its operation the course of the auxiliary-reservoir air through the old main-valve (*black*) of the triple-valve is shown by a yellow line, and the course of the train-pipe air through the new "auxiliary-valve" device is shown by a blue line. Thus in the Complainant's structure, *two* machines are required to perform the two functions.

Now, how are the *auxiliary-valve* 41 and passage 46 constructed? what relation do they bear to the triple-valve device? how are they combined therewith? whether they may be integral therewith or must they be segregated therefrom? and how is the auxiliary-valve actuated, or rather *governed*, by the old device to which they are *added*? This is the key to a correct understanding of the invention of the new combination patented. Everybody agrees that, as shown and described, the *new* parts are physically distinct and separate from the *old* parts, to which they were added and are operated by the *usual* further or extreme traverse of the triple-valve piston (of the old 220,556 device), the stem thereof striking the valve 41 (colored red) on such further or extreme traverse and unseating it, hence uncovering the passage 46 (colored red), which leads from the train-pipe *direct* (and not through any port passage or chamber of the old triple-valve element), train-pipe air will pass directly to the brake-cylinder.

Complainants Structure of Patent 360,070

With the Valves in the Quick-Action Position.



The course of the Auxiliary Reservoir Air through the old Main Valve (black) of the Triple Valve is shown by a yellow line, and the course of the Train Pipe Air through the new "Auxiliary Valve" device is shown by a blue line. Thus in the Complainants structure, *two* machines are required to perform the two functions.

In the light of the evidence presented by this record, how can the patent in suit be classified or treated as a pioneer patent? Both in its general and in its particular descriptions the invention is referred to in the patent as consisting of a novel combination of mechanisms, the major portion of which is admittedly old. We were told by the learned counsel for the complainant, in their printed briefs in the Circuit and Appellate Courts, and truthfully told, that the invention in question consists really of two machines in one—two separate and distinct machines—the new element wholly separate and distinct, both functionally and physically from the main (the triple-valve) mechanism. Not a single one of its elements is connected, physically or otherwise (except that they are both in the same casing) with the main machine; not a single element of it plays any part in the performance of the work of the main machine, nor do they alter, add to, affect or vary in the most remote manner the function or operation or result of the main machine as a triple-valve proper. The latter remains in this new combination, as an element thereof, with the *same* mode of operation as it always had, precisely as it is described in the previous expired patent, No. 220,556, granted to Westinghouse. In other words, the present invention is built upon the triple-valve of this prior patent, without any change whatever in *its* construction or in the mode of operation of any of its parts. In the words of the patent in suit, the invention consists of the old triple-valve of patent 220,556, “provided with certain *additional* members,” which the specification shows are auxiliary thereto, but mechanically independent therefrom, in order that these additional members may be actuated by the other and old element under certain conditions—*i. e.*, when its piston makes its old “further” or full traverse and so contacts with and moves the valve of the added machine, which produces an additional function.

Now, what is this additional function, and what is the new result obtained or sought to be obtained? The former is described generally as the admission of train-pipe air direct to the brake-cylinder; and the latter as quickening the action of the brake, as the chief object. Let us see what is the effect of the admission of the train-pipe air direct to the brake-cylinder. It is certainly not a quickening of the action of the valve itself.

The triple-valve of patent 220,556 is undeniably as quick in action—as a single valve—as the machine of the patent in suit. What is meant by “quick action” is quick *serial* action of a number of such valves placed in sequence under the cars of a train; and this quickening of action is effected because the discharge of train-pipe air *at each valve* hastens the action of the succeeding valve; in other words the train-pipe is vented *at each valve*, instead of (as in the old automatic brake) at the one opening, at the engineer’s valve on the engine. But did the patent in suit, for the *first* time, disclose this underlying principle of quick action or quick serial action? Assuredly not; as the record clearly shows (page 666).

It is fully contained in an earlier patent, No. 217,833, dated July 22, 1879, granted to Mr. Westinghouse, in which he said (p. 759):

“It sometimes happens with such brake apparatus, especially in case of accident, that material advantages could be effected by having all the brakes of the train applied or brought into action *simultaneously*, or *nearly* so as possible. To accomplish this it is only necessary to make provision for the simultaneous opening of one or more ports in the air-conduit passages at points not remote from each auxiliary-reservoir.”

And this description in the patent follows a reference to the applicability of that principle and that invention to the triple-valve or automatic brake. Now, this fact is of prime importance because, while this old patent does not, nor do we pretend that it does, disclose the *mechanism* of the patent in suit, it does disclose the principle of serial venting of the train-pipe at each car, which underlies and characterizes the invention of the patent in suit, and deprives it of all semblance of right to be classified as a pioneer patent for quick serial action.

It is very important that your Honors should give due weight to this evidence of the condition or prior *state of the art*, because it affects, to a certain extent, *the range of equivalents* to which the patent in suit may be entitled. And the condition of the art, disclosed by this prior patent, No. 217,833, as well as by the triple-valve patent, No. 220,556, lies at the very threshold of the enquiry in this, as in all other cases, as to what is legally included within the claims, wholly apart from and in addition to the descriptive limitations in the body of the specification of the patent in suit.

No one can read the specification of the patent in suit, without reaching the conclusion that the *essence* of the invention consists (as admitted by counsel in the extracts above quoted from their Circuit and Appellate Court briefs) in combining *two separate and distinct* machines, one old and the other new, the latter in no manner a part of the old device, mechanically or functionally.

DEFENDANT'S MACHINE.
(See diagram opposite following page.)

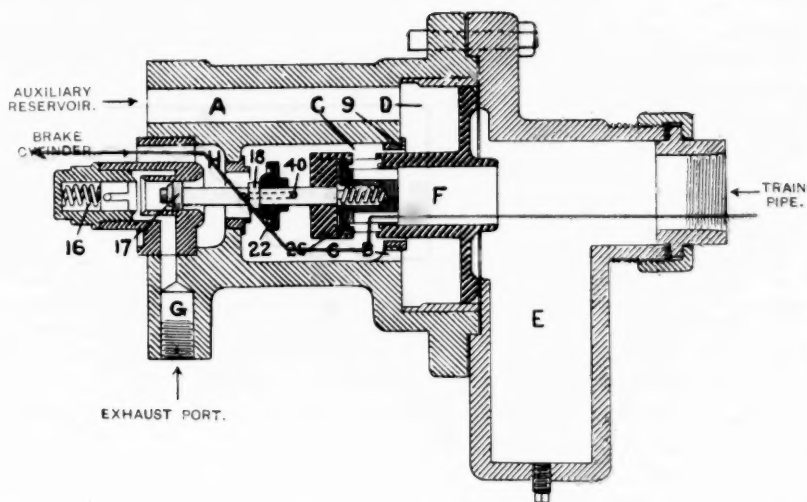
On the other hand, the defendants machine does not consist of two machines combined, but of one machine, and that the old one, improved and improved in a part which never before, by any one in the world, was ever thought could be improved or modified, viz. by separating the triple-valve chamber into two chambers communicating with each other through a small opening; in plain words, inserting a *bushing or partition* therein and so producing *differential pressures* in the chambers C and D on either side of said partition, thereby having a high pressure in piston chamber D (70 lbs.) to hold the piston back, and a lower pressure in the valve chamber C (about 5 lbs.), thus permitting the train-pipe air (shown by a blue line) at 55 lbs.) to open the feeding-in valve of the triple-valve, and passing into the chamber C, therein commingling with auxiliary-reservoir air (shown by a yellow line), and *both* airs passing together to the brake-cylinder, through the port opened by the *old* main-valve 22 (black) of the original triple-valve. In other words making *one* valve, the said main-valve 22, perform the *two* functions of simultaneously admitting both airs to the brake-cylinder. This was more than an invention; it was a discovery, a revelation of the latent powers of the old machine, made wonderfully effective by the most simple change, and in a part of the device never before attempted to be modified, and which the skill of the mechanic would never suggest to him to alter, add to or modify to produce the effect sought for. The means adopted to produce the primary result obtained, *i. e.*, differential pressures, producing the desired secondary effect, could never be *reasoned* out from anything then known in the art; certainly not from anything contained in the plaintiffs' patent. It was a great invention, and the widest possible departure from the principle on which 360,070 is constructed, wherein *two* (the old and a new) machines are required,

Opposite is a diagram of the defendants' device. In its operation, the course of the auxiliary-reservoir air, through the port opened by the old main valve 22 (black) of the triple-valve, to the brake-cylinder, is shown by a yellow line, and the course of the train-pipe air, commingling with the auxiliary-reservoir air and passing together through the same old main-valve port, to the brake-cylinder, is shown by a blue line, thereby utilizing the old main-valve 22 of the triple-valve to perform both functions. Thus in defendants' structure only *one* machine, the old triple-valve, is required to perform the two functions.

Let us critically examine it. We have seen that Westinghouse started with the old triple-valve and *added* new valve parts, forming a second machine, which are physically segregated from the old, and only brought into action when (under a great release of pressure in the train-pipe) the movable part (the piston) of the old makes its *usual* full (further) traverse, which causes it to *contact with* the movable element (the valve 41) of the new or *added* parts. Now, on the other hand, Mr. Boyden also started with the old triple-valve, and desiring to accomplish the same final (secondary with him) *result* as Westinghouse (which he had a perfect right to do if he did it by substantially different *means*), viz., admit train-pipe air as well as reservoir air to the brake-cylinder, he devised entirely novel means to produce that result, not by *adding* any auxiliary-valve nor any additional passage-way controlled thereby, but he utilized *the same passage-way and the same valves* of the old triple-valve to perform the double function, viz: (a) Its old function of admitting reservoir air, and (b), the new function of admitting train-pipe air; and he did this by means of ingeniously partitioning the old triple-valve chamber so as to produce *differential pressures* therein under the conditions required, which said means (the subject of Boyden's patent 481,134) are so obviously different, not only structurally but in principle of construction and operation from that of the Westinghouse device of patent 360,070, that both the Circuit Court for Maryland and the Court of Appeals for the Fourth Circuit unhesitatingly so found *as a fact*. Both courts concurred in finding that claims 1 and 4 of patent 360,070 (which *expressed* the necessary features of that device) were clearly not infringed,

Defendants Structure.

With the Valves in the Quick-Action Position.



The course of the Auxiliary Reservoir Air, through the port opened by the old Main Valve 22 (Black) of the Triple Valve, to the Brake Cylinder, is shown by a yellow line, while the course of the Train Pipe Air, which commingles with the Auxiliary Reservoir Air in the Valve Chamber C and passes through the same port to the Brake Cylinder, is shown by a blue line. Thus in Defendants Structure only *one* machine, the old Triple Valve, is required to perform the two functions.

The Circuit Court says, in its opinion (p. 844):

"In the Boyden mechanism, which is alleged in this case to infringe, I have not been able to satisfy myself that Boyden makes use of an auxiliary-valve in the sense in which the term is employed in the specifications, and some of the claims of the patent No. 360,070 "in suit."

And again he says (p. 844):

"So, I take it, that the defendants' valve i, k, j (40) must "be held to be the *sensitive graduating valve* usual in "triple-valve devices since the Westinghouse patent No. "220,556; and the Defendants' valve 22 must be considered to be the main valve, and that in defendants' "mechanism he has been able, by an ingenious arrangement restricting the admission of auxiliary-reservoir air "to the triple-valve chamber, *to cause the main valve* to "do both main-valve work when needed and to do quick-action work when needed."

The learned judge, having thus found as a *fact* that the Boyden machine did not contain the elements which distinguished and characterized the novelty of the Westinghouse machine, now, why did he hold that Boyden's device infringed the *second claim* of 360,070 (and not the first and fourth), and why did the Court of Appeals for the Fourth Circuit concur with the Circuit Court in its finding of non-infringement of claims 1 and 4 and differ with it as to claim 2 and reverse its finding as to the construction of claim 2 and the issue of infringement based thereon?

The answer is very easily ascertained from the face of the two opinions without searching the record; and upon them we can safely rest a conclusion as to whether or not the decision of the Court of Appeals for the Fourth Circuit, complained of, is correct. That answer is to be found in the following facts; and they show conclusively, not only that the decision of the appellate tribunal was correct, but that it is in full accord with the decisions in the Second Circuit *on the same question, i. e.*, on the construction and interpretation of claim 2. These leading facts are as follows:

1. As before stated, the devices of both parties litigant are founded upon and evolved from, the old triple-valve (shown in prior expired patents). That old device contained a piston which actuated a main-valve; that piston in the device of 220,556 and others had *two* traverses, one a preliminary or partial

traverse for a part of its possible throw, and the other a further or final or continued traverse for the full extent of its possible throw. The *main-valve* of the triple (of 220,556) had as an adjunct a sensitive graduating-valve mounted within it, which was first moved by the partial traverse of the piston and opened a port through the main-valve, for ordinary or "graduated" braking, such partial or preliminary traverse of the piston (whether it was sufficient to move the graduating-valve and the main-valve or the former only) was sufficient to do all the *graduated* work required, *i. e.*, let enough air pressure enter the brake-cylinder; but when full or maximum pressure was *quickly* desired the piston was given its full or further traverse, and the main-valve then included and performed the whole work, which was commonly denominated an "emergency" application of the brakes. This explanation is *essential* to bear in mind, in order to have it clearly understood that the triple-valve piston of the old device of 220,556 had not only a *preliminary traverse*, but a *further traverse*, precisely as it has, and no other than it has, in the improved device of the patent 360,070 here in suit.

With this explanation let us look at the second claim, italicizing it as the Court of Appeals did:

2. In a brake mechanism, the combination of a main air-pipe, an auxiliary-reservoir, a brake-cylinder and a triple-valve having a piston whose preliminary traverse admits air from the auxiliary-reservoir to the brake cylinder, *and which by a further traverse admits air direct from the main air-pipe to the brake-cylinder*, substantially as set forth.

The Circuit Court obviously construed this claim improperly, for two reasons: (a) because it erroneously, or rather mistakenly, found as a premise that the "further traverse" in and of itself was a new and "unusual" traverse of the piston. It has been clearly shown that it was not new and unusual, but precisely the same "further" traverse that it always had. The claim in question is an exact description of the old automatic brake and the old triple-valve of patent 220,556 (patents for same having expired) in its statement of the elements and in its statement particularly of the preliminary and further traverses of the triple-valve piston (the former for graduating and the latter for emergency service), the said claim stating nothing new quoad the old device of patent 220,556, except the "result" obtained

by such *further* traverse in this new combination, viz: "Admits air *directly* from the *main air-pipe* (train-pipe) to the brake cylinder;" and, as these words were followed by "substantially as set forth," of course some *means* (even generically considered) *of the character described in the specification* were to be read into the claim by implication, as otherwise it would be obviously void as claiming a mere result or function. Now this is exactly what the Court of Appeals did. It found that the Circuit Court was wrong, and confessedly (by reference to prior patent 220,556) obviously wrong, in supposing that the "further traverse" mentioned in the claim was "new and unusual;" and this being so, that if the claim was to be interpreted literally to include a combination comprising no other elements than those named (all of which were old separately and in the same combination and acting as such only in the old way) that the claim, as thus construed, could not be differentiated from the prior art, except by the words "admits air direct from the main air pipe to the brake cylinder," which was clearly claiming a "function" or "result" and not the means, and particularly not the means pointed out in the specification to produce the result named.

But the Court of Appeals did not stop there, nor did it adjudicate that the claim was necessarily to be adjudged invalid and void, or "fatally defective," under any and all possible constructions of it, as mistakenly averred by the Westinghouse Company's counsel in the petition for certiorari.

The Court of Appeals having found, and correctly found, that Judge Morris was in error in supposing that the "further" traverse of the piston, referred to in the claim, was new, there was nothing left in the claim, descriptive of the new parts of the machine, except the words "admits air directly from the main air-pipe to the brake-cylinder," which it is useless for anybody to deny are descriptive only of the "result" sought for, and not of the means to produce that result. The Court of Appeals having thus corrected Judge Morris in his finding of *fact*, in this regard, of course was obliged to reject his standard of comparison of the two machines—i. e., a comparison of them by their functions or results, as a whole, and not by their mechanisms; and proceeded to determine for itself what was the true interpretation of the claim.

In doing so, Judge Hughes is careful to state (which statement would otherwise be wholly unnecessary) that—(p. 877):

“The phrase ‘substantially as set forth’ is technical, and equivalent to saying ‘by the means described in the text of the inventor’s application for letters patent, as illustrated by the drawings, diagrams and models which accompany the application.’ These words limit the general terms of the specification which set out the *function* performed by the invention, and confine the inventor’s rights to his own *means* or their mechanical equivalent of performing the function.”

(The italics are the Court’s and appear in the Opinion.)

Now, having shown that the Circuit Court erred first in its finding of fact that the “further traverse” of the piston, spoken of in the claim, was “new and unusual,” and hence necessarily erred in its construction of the claim based on such mistake in fact, the Court of Appeals proceeded thereupon to show, as stated, that if it construed the claim without any limitations and literally upon what was new in it, it would perforce be obliged to hold the claim fatally defective as covering a result only, because the statement of the result (“admits air directly, etc.”) was the only new thing stated in it, and hence that under such construction it would be acting contrary to settled doctrine if it held the claim to be otherwise than “fatally defective” under such conditions. But it did not make any such *adjudication*, because it proceeded to discuss the effect of the words “substantially as set forth,” holding that “these words limit the general terms which set out the *function* and confine the inventor’s rights to his own *means* or their mechanical equivalent of performing the function.”

Hence the Court of Appeals proceeded to ascertain and determine what were these *means* and to give a broad and general definition thereof, limiting them only by the absolutely necessary limitations inherent in the device itself, and as expressed in the specification. The learned Judge’s “Statement of the Case” preceding the opinion, and the opinion itself, clearly show this to be so. In the former he said (p. 875):

“To repeat, his (Westinghouse) device for this purpose consisted in attaching to the pre-existing triple-valve, as patented in number 220,556, a machine which embraced an additional stem, an additional valve and additional air-passages leading from the port in the

"new valve to the brake-cylinder. This new attachment is put into action for emergency purposes by the triple-valve piston when on its extreme traverse. The previous machine, 220,556, had provided for the extreme traverse of that piston by which it had put in action the main-valve at the end of its old stem, and opened a full and direct flow of compressed air from the auxiliary-reservoir into the brake-cylinder for use in emergencies. Thus the new contrivance, by the *same* extreme traverse of the triple-valve piston, continued the old flow of compressed air for emergency purposes and provided an additional flow of the air for emergency purposes by an additional mechanism; this latter flow being directly from the train-pipe, and the former flow being from the auxiliary-reservoir. Such was the make-up of patent 360,070—two machines in one box or case."

Preceding the above-quoted paragraph the Court of Appeals took occasion in defining the old triple-valve of 220,556 to say (p. 873):

"With this brake of patent 220,556, gradual stopping and slowing was executed by giving the piston a partial or half-traverse in its chamber, by which air passed through the sensitive-valve on the stem of the piston to the brake-cylinder; and emergency stopping was done by a full or extreme traverse of the piston in its chamber, which closed the sensitive-valve in its stem and opened the main-valve fixed upon the end of the stem, and allowed a full and direct venting of air from the auxiliary-reservoir into the brake-cylinder."

And also remarking in succeeding paragraph the following (p. 874):

"In the Westinghouse Automatic Air-brake, as patented in number 220,556, the ordinary work of braking was performed by a partial traverse of its chamber by triple-valve piston, graduated, according to the purpose desired, at the will of the engineer; and emergency work was done by an extreme traverse of the piston to the end of its chamber. * * * The text and diagram of 220,556 show that even a full or extreme traverse of the piston in its chamber would vent no other compressed air into the brake-cylinders except from the auxiliary-reservoirs."

Having thus defined the prior art (as shown in the patent 220,556), and conclusively established that the Circuit Court was mistaken in saying that the "further traverse" of the piston

was "new and unusual," and having also shown thereby that every element both separately and in the same combination, and their and its mode of operation, *expressed* in the second claim, was old, the learned judge, speaking for the Court of Appeals, proceeding to detail the evolution of the two devices of the Plaintiffs and Defendants herein, said, in the following extract from succeeding paragraphs (p. 874):

"It is admitted on both sides that while the mechanism "220,556, though effective for the ordinary purposes of "braking, was not effective for abruptly stopping long "trains in sudden emergencies. This deficiency of the "Westinghouse brake, in the stage of improvement which "it had reached in patent 220,556, created the necessity "for some additional invention whereby could be accom- "plished an instantaneous and simultaneous application "of all the brakes of every car.

"Each of the chief contestants in the present suit set "himself laudably to work in devising a means to "accomplish this important desideratum, each taking the "air-brake, patented as numbered 220,556, Westing- "house's exclusive property in which has expired, as the "basis of his new device, the common object being to "produce a mechanism by which to secure instantane- "ously, whenever and only when a sudden emergency "arose, such a quickened discharge of compressed air "into the several brake-cylinders that each car would "simultaneously, and the entire train as a whole, be "brought to a sudden halt, but leaving all the mechanism "already existing for use in ordinary braking unmolested "and unchanged. Westinghouse devised for each car an "additional valve, which he so attached to the triple-valve "of patent 220,556 that when the piston should be in "complete traverse and driven to the end of its chamber, "it should drive forward an additional stem provided for "this additional valve, and thereby open a port in that "valve by which compressed air from the train-pipe "should pass, through by-passes independent of the "triple-valve, into the brake-cylinder into which the "triple-valve vented compressed air from the auxiliary- "reservoir. By this device of the additional stem, the "additional valve and the independent by-passes into "which the latter opened, the inventor contrived to dis- "charge compressed air from both the auxiliary-reservoir "and the train-pipe into the brake-cylinder of each car "simultaneously, and thereby so quickened the action of "the brakes as to accomplish the desideratum of quick "action.

"Boyden also made a successful invention of venting compressed air from the train-pipe into the brake-cylinder of each car, simultaneously with venting air from the auxiliary-reservoir to the brake-cylinder, as had been done for emergency purposes by the previous triple-valve of patent 220,556. He did not resort to a second machine. He did not devise an additional stem, an additional valve, or by-passages independent of those of the triple-valve. He accomplished the transmission of compressed air directly from the train-pipe to the brake-cylinder by other means."

The foregoing quotations are from the "statement of the case" preceding and made a part of the opinion proper. In the latter, comparing the Plaintiff's and Defendant's devices, the Court said (p. 878):

"The same result was accomplished by the two devices, but these had but one means in common. Each used one common mechanical movement of the main piston, which was a movement described in the patent which had expired. But the further mechanism employed, respectively, by the two inventions were, respectively, as has been described.

"The transmission of train-pipe air and auxiliary-reservoir air simultaneously to the brake-cylinder is a result or function, and is not patentable. The means by which this or any other result or function is accomplished may be many and various, and if these several means are not mechanical equivalents, each of them is patentable. The question at bar is, whether Boyden's brass-ring partition with the port it contains, inserted in and made a part of the triple-valve itself, successfully accomplishing the function of discharging train-pipe air into the brake-cylinder simultaneously with the triple-valve's discharge of auxiliary-reservoir air into that cylinder, is the mechanical equivalent of Westinghouse's attached machine, non-integral, segregate and individual, consisting of another stem, another valve and by-passages peculiar to itself leading from the additional valve to the brake-cylinder, both devices being put in action by the triple-valve piston when on its old extreme traverse."

Can anything be plainer than that the Court of Appeals *adjudicated*, not that the 2d claim was void if properly construed, but that it should be construed (and properly so) as a claim for the *means* of producing the result stated in the claim? And, so construing it, the Court said (p. 880):

"Comparing the two devices apart from the triple-valve piston in extreme traverse, we are unable to entertain a doubt that the ruling of the Patent Office was correct to the effect that Boyden's device was not the mechanical equivalent of that of Westinghouse. They seem to us to differ as widely from each other as two devices for accomplishing the same result can well differ."

If it had meant to say, and had adjudicated, that the said 2d claim was fatally defective and void, under any permissible interpretation of it (as the plaintiffs mistakenly asserted in their petition for *certiorari*), there would have been no necessity for saying, and indeed it would have been surplusage to say, on the issue of infringement, the matter quoted in the above paragraph.

And this finding of fact by the Court of Appeals differentiating between the two devices in question, and adjudging their non-identity as mechanisms, is in full accord with a like finding of fact in the case at bar, by the Circuit Court, as will appear from the following quotation from the opinion of that Court (p. 844):

"In the Boyden mechanism, which is alleged in this case to infringe, I have not been able to satisfy myself that Boyden makes use of an 'auxiliary-valve' in the sense in which that term is employed in the specification and in some of the claims of the patent No. 360,070, now in suit. It appears from the specification of patent No. 360,070 that what Westinghouse meant by the 'auxiliary-valve, which is made one of the elements of the combination in the first and fourth claims, is such a valve as he has described in his specification, and which is independent of and performs none of the functions of the main valve of the ordinary triple-valve device."

Thus it is demonstrated to an absolute certainty that claim 2, in order to make it a claim for anything but the "result" sought for, i. e., "admits air directly from the main-air-pipe to the brake-cylinder," must be construed by implying the *means* to produce that result, and hence, is inclusive of means which are "auxiliary" to the triple-valve and "independent" of the main valve thereof; and these quoted words are the only limitations which the defendants sought to apply; and they are

required not only by the principle of construction and operation of the device, apparent on the face of the patent itself, but by the matters appearing in the file and contents of the application therefor.

Indeed, the plaintiffs, while now shifting their position, conceded these limitations in the Circuit and Appellate Courts, in the extracts already quoted herein from their brief in those Courts. (See quotation page 9 of this argument).

In corroboration of its conclusion stated, the Court of Appeals took occasion to remark that the decision of the Patent Office in granting a patent (No. 481,134) to defendant (Boyden) for his device was corroborative evidence of the non-identity of the device of the Defendant with that of the Plaintiff. The Court was very careful to say that this was only evidence, and was not conclusive. For the purpose of proving non-identity the Defendants' patent was admissible as evidence, and properly considered as such, in view of the decisions of this Court in *Corning vs. Burden*, 15 Howard, 252, and *Miller vs. Eagle Co.*, 151 U. S. 186 (208), in which latter case this Court said:

"Again, the issuance of the patents to (Defendants' assignors) creates a prima facie presumption of a patentable difference from that of the Plaintiff's patent."

In concluding its opinion, the Court of Appeals properly examined and considered the decisions in the Second Circuit, in which the same patent 360,070 was in controversy as the foundation of the suit, in which the opinion by Judge Lacombe (65 Fed. Rep. 99) was affirmed by the Court of Appeals, in a per curiam opinion (69 Fed. Rep. 715).

Judge Lacombe's opinion in that case (p. 101 of the report) quotes the first claim of patent 360,070, and in discussing its terms by comparing that defendant's device therewith, element by element, used the word "auxiliary" in connection with the added valve device, and the word "independent" in defining its location and operation relatively to the "main" valve. After doing so he quotes the second claim, and says "the discussion of the first claim applies equally to this one. In the first claim actuation by the piston of the triple-valve was made an element. In this claim (the second) the inventor more closely limits the mode of such actuation. It is to be by a further traverse of that piston," etc.

He thus takes a view of that claim entirely antagonistic to that of Judge Morris, because it is evident that he considers claim 2 *more limited in its scope* than claim 1; and equally so that he perceives the necessity of including in claim 2, with the triple-valve, "an auxiliary-valve," and impliedly a port and passage governed thereby leading *directly* to the brake-cylinder; and that he found this combination in the New York defendant's device, because, he says—

"It has the main air-pipe, an auxiliary-reservoir, a brake-cylinder, a triple-valve, and an *auxiliary-valve* device, *independent of the main-valve*, for admitting air in the application of the brake *directly* from the main air-pipe to the brake-cylinder. The means for actuating the auxiliary-valve device is stated in the claim to be the piston of the triple-valve and the way in which it acts, as shown in the patent, is by direct impingement upon the stem of the auxiliary-valve device."

(The italics are not in the opinion).

There can be no doubt that Judge Lacombe was right, both in his view of claim 2 and of the infringement of that claim by the defendants in the New York case; and if so, there is equal certainty that Judge Morris was wrong on both these questions in the case at bar, and was properly reversed.

Can any one entertain for an instant a reasonable doubt that Judge Lacombe thought the second claim was not inclusive of an "auxiliary" valve, "independent" of the main valve? It cannot be so pretended with any reasonable hope of belief that he entertained any such view of claim 2 as did Judge Morris, or that he entertained any view thereof substantially different from that adopted by the Circuit Court of Appeals for the Fourth Circuit in the case at bar.

Corroborative evidence of this is furnished by the diagram of the device of the defendant in the case decided by Judge Lacombe, which diagram is annexed to and forms a part of the opinion of the Court of Appeals in the case at bar. (Page 883.)

In his injunction opinion, Judge Lacombe, in reference to the previous decisions in the New York suits, states:

"In these opinions it is held that the two patents, 360,070 and 376,837 disclosed, the one the emergency-valve (auxiliary-valve), the other the supplemental piston or special motor, which, *so far as the art has now*

"progressed appear to be *both* essential to the structure
"of the successful quick-action air-brake."

In expressing this opinion Judge Lacombe correctly deems the "auxiliary-valve" 41, of patent 360,070, and the supplemental piston of patent 376,837, as being "*both essential* to the structure of a successful quick-action air brake" as used in the Westinghouse system. He also says, incorrectly however, that these devices illustrate "the art as far as it has now progressed." Evidently the learned Judge had no knowledge of the later patents issued to Boyden where a new departure is made in the art, and wherein (see Boyden Patent No. 481,131, page 805, fourth paragraph) is disclosed the fact that a triple-valve "*per se* without auxiliary or supplemental-valve devices" and "*a single-valve*—the main valve of the triple proper—is made to perform the office of opening communication to the brake-cylinder from both the train-pipe and the auxiliary-reservoir in the quick application of the brakes for emergency stops."

Judge Lacombe had before him the question as to whether or not a brake mechanism employing alleged *different mechanical means* for opening an "*auxiliary valve*" which governed an *independent* port and passage to the brake-cylinder is an infringement of both the aforesaid Westinghouse patents?

This court has before it a very different question, to wit: whether or not in a triple-valve device an old *main* valve (22) of the triple, which continues as formerly, to perform the old *main* valve function of admitting auxiliary-reservoir air to the brake-cylinder to set the brakes, is now any the less the *main* valve of the "triple," and any the less the same valve that it always was, because it now also performs an added function, namely, admitting train-pipe air direct to the brake-cylinder through the *triple-valve chamber*, and without the use or employment of an independent or separate additional passage-way to the brake-cylinder? In answering this question it must be borne in mind that Mr. Boyden gave the old triple-valve the new capacity to do a *double* duty, or to perform the added function without an auxiliary-valve, and without any additional port or passage-way, by adding his own most ingenious discovery of the effect of *momentary differential pressures* in the triple-valve chambers, applied and accomplished by inserting the

partition or ring 9, with a passage B, to separate or divide the triple-valve chamber C from the piston-chamber D, and thus deliver train-pipe air, when desired, through the triple-valve chamber itself, direct to the brake-cylinder, the main valve of the triple being the governing means for admitting both reservoir air and train-pipe air to the brake-cylinder, instead of separate valves and passages, as in the plaintiffs, for effecting or governing those two distinct functions.

If, therefore, we accept Judge Lacombe's construction of claim 2 as the standard by which to determine whether or not the *Boyden* brake is or is not identical in principle of construction and operation with the Westinghouse device of the patent in suit, no one can entertain any reasonable doubt that the decision of the issue of infringement must necessarily be in favor of defendants in case at bar.

There was no denial on the part of the defendants in the last New York suit, that they used an "auxiliary-valve" and an independent passageway *to admit train-pipe air direct to the brake-cylinder*, their contention being that complainants' patents are only for specific means for actuating the emergency or "auxiliary valve" to control such passageway, and that they (the New York defendants) did not use the said *specific means*, and therefore did not infringe.

As to this the New York Court said, in effect: "The slightly different means which those defendants employed to actuate their '*auxiliary-valve device*' is within the doctrine of equivalents." And the Court was undoubtedly right in that.

But in the case at bar the issue is wholly different. The defendants herein show that in *their* structure, train-pipe air is admitted to the brake-cylinder by the "triple-valve" *per se, without the aid of a separate and independent port and passage, and without an "auxiliary-valve" or any valve other than the old main-valve of the triple; and that this result is accomplished by defendants by wholly novel means, confessedly new with Boyden*, and so (three times) adjudged to be (1) by the Patent Office, (2) by the Circuit Court and (3) by the Court of Appeals.

In the New York case, Judge Lacombe discusses the file and contents of patent 360,070, and says:

"There is nothing in the file wrapper or contents (360,070) to show that the Patent Office required, or that the inventor agreed to abandon, *what was the great feature of his invention, the emergency valve*, (the 'auxiliary valve' 41) or to give up whatever range of equivalents his patent might, as modified, fairly cover."

Of course not, and *we* don't contend that there is anything in the file wrapper and contents to show that the Patent Office required the inventor to give up what was "the great feature of his invention—the emergency valve," namely, the *auxiliary valve* 41, and the port and passage 46 governed thereby, to admit train-pipe pressure *direct* to the brake-cylinder. The file wrapper, however, *does* show clearly that the Patent Office *did* require him to give up the original and erased first claim for a triple-valve, "*provided with a device*" (generically) for admitting air directly from the main air-pipe to the brake-cylinder, and in cancelling said claim he cancelled the statement calling for an imaginary *integral* structure for that purpose. Therefore patent 360,070 *does not cover that*, and to confirm this act his letter accompanying the cancellation defines the novelty of his invention as residing in the *combination* with a *known triple-valve* of an "additional" and *auxiliary valve* adapted to be *actuated* by the piston of the triple to govern an *independent* port and passage leading *directly* to the brake-cylinder.

Mr. Westinghouse undoubtedly made a new invention, which, in the improved form shown in his later patent, is valuable and deserving of great commendation, and his patent therefor should be given a liberal construction, limited only by the necessary as well as by the self-imposed limitations clearly expressed in the patent itself. Judge Lacombe in defining it and construing the claims has imposed no greater limitations than we contend for, viz., that the new and "additional members" in the combination, no matter what their specific character, shall be physically and functionally "auxiliary" to the triple-valve proper (the old element which in the new Westinghouse combination is used without change and precisely as it was before) and that as respects the auxiliary or emergency valve it shall be "independent of the main-valve," and that the passageway governed thereby shall lead "*directly* from the main-air pipe to the brake-cylinder" (to quote the words of claim 2.)

Whether the patent in question be a pioneer or a mere improvement patent, cannot in either case warrant the application of any rule of construction which disregards these fundamental principles governing the interpretation of patent claims. Neither of the late cases of *Miller vs. Eagle Co.*, 151 U. S., nor *Morley vs. Lancaster*, 129 U. S., afford the slightest ground for so broadly interpreting the claims of a patent, whether pioneer or not, to include functional equivalents of mechanisms which, while producing the same result as those of the patent do so by means which are *not* substantially the same as those of the patent, but are so different in principle of construction and operation therefrom as to make their structural features and operative functions wholly repugnant to and irreconcilable with the description of the construction and operation of the patented mechanism as the same is set forth in the specification of the patent in question. In proof of which this Court said, in respect of the Morley machine, that the claims in question of his patent are not for a result or effect, irrespective of the *means* by which the effect is accomplished. "It is open to a subsequent inventor to accomplish the same result, if he can, by substantially different means." (See page 286 of the opinion.)

The Court of Appeals, in the case at bar, also referred to the file-wrapper and contents of the application for the patent 360,070, not as stated in the Plaintiffs' petition for *certiorari*, but properly as corroboratory of its conclusions already found and stated, from the patent itself, that the "additional" parts constituting the novel elements in the combination patented were (a) an "auxiliary"-valve, "independent" of the main valve, and (b) a "separate" passage way governed thereby, leading "directly" from the train-pipe to the brake-cylinder. And in this connection it is to be noted that the word "directly" appears in the 2d claim.

The application for patent 360,070, as filed by Mr. Westinghouse, contained the following as the original first claim (p. 714):

"1. In a brake mechanism the combination of a main air-pipe, an auxiliary reservoir, a brake-cylinder and a triple valve *provided with a device* for admitting air directly from the main air-pipe to the brake-cylinder; substantially as described." (The italics are ours.)

On objections by the Patent Office, including *inter alia* the citation of a prior patent, Mr. Westinghouse erased this claim.

As a logical conclusion of fact it cannot be open to doubt that the construction he is now asking for claim 2, *as against this defendant*, is exactly the generic but imaginary construction of mechanism which he sought to cover by said erased claim; and as a logical deduction of law from a long line of authorities in this Court, it is equally certain that he is estopped from so doing. Knapp vs. Morse, 150 U. S., 221; Corbin Lock Co. vs. Eagle Lock Co., 150 U. S., 38, and cases cited therein.

The decision in Reece vs. Sewing Machine Co., 61 Fed. Rep., 958, affords no countenance for any qualification of this salutary rule; besides, the facts in that case have no parallel with those in the case at bar. The decision in Reece's case turned on the fact that the narrowing amendment ought not to have been required and was inadvertantly made; but the decision distinctly recognizes the soundness of the previous authorities, which hold the patentee to the usual legal effect of such amendments in matters of substance, if it shall appear that the same were understandingly or voluntarily made, or were in fact necessary in view of the prior references cited, or of the state of the art generally. Indeed, the court refers to and quotes with approval its previous ruling in Ball and Socket Fastener Co. vs. Ball Glove Fastener Co., 58 Fed. Rep., 818, in the following words:

"The rule touching the effect of such amendments has been several times laid down by the Supreme Court in patent cases, although it is only a peculiar application of the general principles of law relative to the interpretation of instruments. In the case at bar, the amendments relate to the very pith and marrow of the alleged improvement, touch directly the question of novelty, and were understandingly and deliberately assented to; so that the rule of interpretation referred to undoubtedly applied."

The contents of the file of the application, in the rejection and erasure of the original first claim, and the explanatory letter of the applicant to the Patent Office, clearly show that the invention patented does *not* consist of some improvement in and of the triple-valve itself, nor in a triple-valve provided with "a device" for admitting air directly from the train-pipe to the brake-cylinder (the erased claim), but consists of a combi-

nation of the old triple-valve with some *added* and *auxiliary* means, physically and functionally independent therefrom, but so arranged relatively thereto as to be brought into action on the same old extreme traverse of the triple-valve piston, and operating to produce its own specific result in the performance of the aggregate results by the combined mechanisms. This is what the applicant, Westinghouse, in his letter to the Patent Office after the rejection of his original first claim meant, when he said he believed "such combination" to be novel. No one disputed that so far as this record discloses. What *is* disputed is his *present* contention that his 2d claim shall be now construed as for means which are *not* "auxiliary" to and *not* "independent" of the triple-valve as previously employed, and for means which are integral with and a part of the triple-valve, comprising modifications in the triple-valve chamber and a utilization of the main-valve, by force of such changes, to perform a double function—*i. e.*, its old triple-valve function and a new one which, but for such changes, it would be incapable of performing. These latter sentences describe this defendant's machine; a device comprising mechanisms never dreamed of by Mr. Westinghouse before he saw Boyden's machine, and which are so radically different in principle of construction and operation from his own, that by no stretch of imagination, based on anything found in patent 360,070, could they have been contemplated by the Patent Office officials to be within any of the claims of Westinghouse's patent as allowed to him.

It is respectfully submitted that there is no error in the decree sought to be reviewed, and that it should be affirmed.

HECTOR T. FENTON,
Of Counsel for Boyden Brake Co.

403 & 406
116
OCT 22 1896
Brief of Church for Boyden &
Supreme Court of the United States

October Term, 1896. Nos. 403 and 406.

Filed Oct. 22, 1896.

BOYDEN POWER BRAKE COMPANY,

GEORGE A. BOYDEN, President,
CHARLES E. MANN, Secretary,
WILLIAM WHITRIDGE, Treasurer.

AND

BOYDEN BRAKE COMPANY,

VS.

GEORGE WESTINGHOUSE, JR.

AND

THE WESTINGHOUSE AIR-BRAKE CO.

Appellants.

APPEAL.

GEORGE WESTINGHOUSE, JR.

AND

THE WESTINGHOUSE AIR-BRAKE CO.

Appellees.

VS.

BOYDEN POWER BRAKE COMPANY,

GEORGE A. BOYDEN, President,
CHARLES E. MANN, Secretary,
WILLIAM WHITRIDGE, Treasurer.

AND

BOYDEN BRAKE COMPANY,

Appellees.

CROSS-APPEAL.

ADDITIONAL BRIEF OF ARGUMENT,
FOR BOYDEN BRAKE CO.

MELVILLE CHURCH,
Of Counsel for the Boyden Brake Co.

Supreme Court of the United States.

October Term, 1896. Nos. ⁴⁰³~~347~~ and ⁴²⁶~~378~~

BOYDEN POWER BRAKE COMPANY.

GEORGE A. BOYDEN, President.
CHARLES B. MANN, Secretary.
WILLIAM WHITRIDGE, Treasurer.

AND

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GEORGE A. BOYDEN, President.
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WILLIAM WHITRIDGE, Treasurer.

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BOYDEN BRAKE COMPANY,

Appellees.

CROSS-APPEAL.

THE SECOND CLAIM OF THE WESTINGHOUSE PATENT NO. 360,070 IS INVALID AND VOID.

The claim reads as follows:

"2. In a brake mechanism the combination of a main
"air-pipe, an auxiliary-reservoir, a brake-cylinder, and a
"triple-valve having a piston whose preliminary traverse
"admits air from the auxiliary-reservoir to the brake-
"cylinder, and which by a further traverse admits air
"directly from the main air-pipe to the brake-cylinder;
"substantially as set forth."

This claim is invalid and void—

(a) Because all its expressed elements were old and were combined in the same way in prior patented structures.

(b) Because, if the claim is read as for a combination other than of its expressed elements, it is a claim for a result.

(c) Because, if so read, it is a claim not only for a result, but for a result that is not useful.

THE COMBINATION OF THE EXPRESSED ELEMENTS OF THE
CLAIM WAS OLD.

The expressed elements of the claim are :

- (1) A main air-pipe.
- (2) An auxiliary-reservoir.
- (3) A brake-cylinder, and
- (4) A triple-valve whose piston has a "preliminary traverse" and also a "further traverse." These elements so combined are all found in the prior Westinghouse patent No. 220,556.

This is easily verified. On looking at Fig. 1 of patent 220,556 (p. 762) there will be found a passage P, P¹ leading from train-pipe to the piston-chamber B¹; a piston G in the piston-chamber constituting the valve for controlling the flow of air through port *a* (shown in Fig. 4) to the passage R leading to auxiliary-reservoir; a main slide-valve H having a passage *s* for controlling communication between the passage C leading from brake-cylinder to the exhaust port E, which opens to the atmosphere; the graduating-valve *e*¹ having its seat in the passage in the main slide-valve H for controlling the flow of air from auxiliary-reservoir to brake-cylinder through port *s*¹ in the slide-valve H and passage C; and the slide-valve H, as a whole, operating, when the piston G makes its further or full traverse under a considerable reduction of pressure in the train-pipe, to entirely uncover passage C and permit auxiliary-air to pass through passage C to the brake-cylinder, to secure the maximum braking effect in an emergency application of the brakes, or when the train-pipe is burst or ruptured.

The "preliminary traverse" of the piston of the device of this patent 220,556 occurs when ordinary service stops are made, while the "further traverse" is made in an emergency application of the brakes by the opening wide of the engineer's valve on the locomotive or upon an automatic application of the

brakes by the bursting of the train-pipe or the parting of the train into two sections.

The importance of the "further" or *full* traverse of the piston is dwelt upon in the Westinghouse catalogue issued in 1886, (page 594), and is testified to by Mr. Newbury, Complainant's expert, (page 263, X. Q. 358; pages 263-4, X. Q. 360-3;) by Mr. H. H. Westinghouse, (pages 270-1, Q. 378, page 328, X. Q. 565;) by Complainant's witness Kidder, a practical locomotive engineer, (page 432, X. Q. 781;) by Complainant's witness, Nellis, another practical locomotive engineer, (page 438, X. Q. 807.)

Limited, then, to a combination of its expressed elements the second claim is anticipated by said prior Westinghouse patent No. 220,556.

IF THE CLAIM IS READ AS FOR A COMBINATION OTHER THAN ITS EXPRESSED ELEMENTS, IT IS A CLAIM FOR A RESULT.

If the claim be not thus limited to the combination of its expressed elements, but, because of its inclusion of the phrase, "and which by a further traverse admits air directly from the main air pipe to the brake-cylinder, substantially as set forth," it is attempted to be extended to cover anything more than the expressed elements plus the "additional" elements described as such in the body of the specification and embodied in the first and fourth claims, it is invalid and void as being a claim for a mere result.

Patents for machines are not granted for an idea, an abstraction or a result, but for concrete, tangible mechanical elements, or combinations of mechanical elements.

In *Burr vs. Duryear*, 1 Wall., 570, this Court, speaking through Mr. Justice Grier, said:

"The Patent Act grants a monopoly to any one who
"may have discovered or invented any new and useful
"art, machine, manufacture or composition of matter.

"That the invention of Wells comes within the category of a '*machine*' cannot be disputed. The law
"requires that the specification 'should set forth the principle and the several modes in which he has contemplated the application of that principle, or character by
"which it may be distinguished from other inventions,
"and shall particularly point out the part, improvement,

“or combination which he claims as his own invention or ‘discovery.’ We find here no authority to grant a patent for a ‘principle’ or a mode of operation, or an *idea*, or ‘any other abstraction. A machine is a concrete thing, ‘consisting of parts, or of certain devices and combination of devices. The principle of a machine is properly ‘defined to be its mode of operation, or that peculiar combination of devices which distinguish it from other machines. A machine is not a principle or an idea. ‘The use of ill defined abstract phraseology is the frequent source of error. It requires no great ingenuity to mystify a subject by the use of abstract terms of ‘indefinite or equivocal meaning. Because the law ‘requires a patentee to explain the mode of operation of ‘his peculiar machine which distinguishes it from others, ‘it does not authorize a patent for a ‘mode of operation ‘as exhibited in the machine,’ much less can any inference be drawn from the statute, that an inventor who ‘has made an improvement in a machine, and thus effects ‘the desired result in a better or cheaper manner than ‘before, can include all previous inventions and have a ‘claim to the whole art, discovery, or machine which he ‘has improved. All others have an equal right to make ‘improved machines, provided they do not embody the ‘same, or substantially the same devices, or combination ‘of devices, which constitute the peculiar characteristics ‘of the previous invention.”

In *Fuller vs. Yentzer*, 94 U.S. 288, this Court speaking through Mr. Justice Clifford, also said:

“Patents for a machine will not be sustained if the ‘claim is for a result, the established rule being that the ‘invention, if any, within the meaning of the Patent ‘Act, consists in the means or apparatus by which the ‘result is obtained, and not merely in the mode of operation independent of the mechanical devices employed ; ‘nor will a patent be held valid for a principle or for an ‘idea, or any other mere abstraction.”

Now, I submit, no candid mind can read the second claim of the patent in suit without concluding that it embodies an

attempt to claim a result. To say that the "further traverse" of the piston of the triple-valve "admits air directly from the main air pipe to the brake cylinder" is simply to state the result accomplished when such movement of the piston takes place. It does not tell us *how* that result is accomplished, *by what means* it is accomplished; but simply that it is accomplished. The claim is in effect for the *doing* of the thing without reference to the way of or *means* for doing it.

The case cannot be distinguished in principle from the leading case of O'Reilly vs. Morse, 15 How., 62. In that great case the eighth claim of the Morse patent, which was held invalid, read as follows:

"8th. I do not propose to limit myself to the specific machinery or parts of machinery described in the foregoing specification and claims; the essence of my invention being the use of the motive power of the electric or galvanic current, which I call electro magnetism, however developed for marking or printing intelligible characters, signs, or letters, at any distance, being a new application of that power of which I claim to be the first inventor or discoverer."

Chief Justice Taney, in delivering the opinion of this Court, said, (page 112:)

"It is impossible to misunderstand the extent of this claim. He claims the exclusive right to every improvement where the motive power is the electric or galvanic current, and the result is the marking or printing in intelligible characters, signs, or letters, at a distance. If this claim can be maintained, it matters not by what processes or machinery the result is accomplished. For aught that we now know some future inventor, in the onward march of science, may discover a mode of writing or of printing at a distance by means of the electric or galvanic current, without using any part of the process or combination set forth in the Plaintiff's specification.

"His invention may be less complicated—less liable to get out of order—less expensive in construction, and in its operation, but if it is covered by this patent the

“inventor could not use it, nor the public have the benefit of it without the permission of this patentee.”

Again, page 119:

“The provisions of the Acts of Congress in relation to patents may be summed up in a few words. Whoever discovers that a certain useful result will be produced, in any art, machine, manufacture or composition of matter, by the use of certain means, is entitled to a patent for it; provided he specifies the means he uses in a manner so full and exact that any one skilled in the science to which it appertains can, by using the means he specifies, without any addition to or subtraction from them, produce precisely the result he describes. And if this cannot be done by the means he describes, the patent is void. And if it can be done, then the patent confers on him the exclusive right to use the means he specifies to produce the result or effect he describes, and nothing more. And it makes no difference, in this respect, whether the effect is produced by a chemical agency or combination; or by the application of discoveries or principles in natural philosophy known or unknown before his invention; or by machinery acting altogether upon mechanical principles. In either case he must describe the manner and process as above mentioned, and the end it accomplishes. And any one may lawfully accomplish the same end without infringing the patent, if he uses means substantially different from those described.

“Indeed, if the eighth claim of the patentee can be maintained, there was no necessity for any specification further than to say that he had discovered that, by using the motive power of electro magnetism, he could print intelligible characters at any distance. We presume it will be admitted on all hands that no patent could have issued on such a specification. Yet this claim can derive no aid from the specification filed. It is outside of it, and, the patentee claims, beyond it. And if it stands, it must stand simply on the ground that the broad terms above mentioned were a sufficient descrip-

"tion, and entitled him to a patent in terms equally
 "broad. In our judgment, the Act of Congress cannot be
 "so construed."

To show how applicable the principle of the Morse case is to the one at bar, the *eighth* claim of Morse and the *second* claim of the patent in suit *paraphrased* are here set up in parallel columns for comparison :

MORSE'S VOID EIGHTH
 CLAIM.

"8th. I do not propose to
 "limit myself to the specific
 "machinery or parts of ma-
 "chinery described in the fore-
 "going specification and claims,
 "the essence of my invention
 "being the use of the motive
 "power of the electric or gal-
 "vanic current, which I call
 "electro magnetism, however
 "developed for marking or
 "printing intelligible charac-
 "ters, signs, or letters, at any
 "distance, being a new appli-
 "cation of that power of which
 "I claim to be the first in-
 "ventor or discoverer."

WESTINGHOUSE'S SECOND CLAIM
 PARAPHRASED.

2d. I do not propose to
 limit myself to the specific
 machinery or parts of ma-
 chinery described in the fore-
 going specification and claims,
 the essence of my invention
 being the use of that part of
 the motion of the triple-valve
 piston, which I call the "fur-
 ther traverse," however devel-
 oped for admitting air
 directly from the main air-
 pipe to the brake-cylinder,
 being a new application of
 that piston-motion of which
 I claim to be the first in-
 ventor or discoverer.

This is not an unfair comparison. Morse endeavored to cover the use of the motive power of the electric or galvanic current for printing intelligible characters, signs or letters at any distance without any limitation as to the means to be employed, while Westinghouse, in like manner, attempted to cover the use of the motion of the triple-valve piston to admit air directly from the main air-pipe to the brake-cylinder, irrespective of the kind or character of the means employed for achieving that result. It was the omission of the printing or recording devices by which the result of printing intelligible characters at a distance was accomplished that rendered the eighth claim of

Morse invalid, just as it is the omission of the additional auxiliary-valve device by which the result of admitting train-pipe air directly to the brake-cylinder is effected that renders the second claim of Westinghouse invalid.

Both Morse and Westinghouse tried to appropriate an idea to cover all ways and means of effecting a result, and the condemnatory language of this Court applies to each of them with equal force.

THE RESULT CLAIMED AS A USELESS RESULT.

Not only is this second claim a claim for a mere result, but it is also a claim for a result that is not useful, and, hence, in any view not patentable.

The second claim, like the first claim, refers to the specification by the phrase "substantially as set forth," but nowhere in the specification is it suggested that any brake apparatus had been conceived of by the patentee wherein the result of quick action could be accomplished by the mere admission of train-pipe air alone, "directly from the main air-pipe to the brake-cylinder."

The only apparatus described or hinted at in the patent for accomplishing quick-action is an apparatus in which, upon the full or further traverse of the piston, train-pipe air *and* auxiliary-reservoir air are *both* admitted, substantially simultaneously, into the brake-cylinder.

The claim, therefore, not only states a result, instead of competent mechanism for accomplishing a result, but it states a result that the patentee had not indicated might be accomplished, and a result that, according to what is stated in the specification and in the evidence of all the experts in the case, is entirely lacking in utility.

If it is conceded, as it must be, that the additional function or result of admitting auxiliary-reservoir pressure as well as train-pipe pressure to the brake-cylinder during the further traverse of the piston *is necessary*, but is contended that the Court may read into this second claim such additional function or result, the complete answer is, that, to do so, would make the second claim identical with the third claim, that is not in

issue and that is not alleged to be infringed, which reads as follows :

"3. In a brake mechanism, the combination of a main air-pipe, an auxiliary-reservoir, a brake-cylinder and a triple-valve having a piston whose preliminary traverse admits air from the auxiliary-reservoir to the brake-cylinder, and which by a further traverse admits air directly from the main air-pipe to the brake-cylinder and effects a *second admission of air from the auxiliary reservoir to the brake-cylinder*; substantially as set forth."

This third claim, like the second claim, is clearly void because embodying an attempt to claim a result, but it at least has the merit of stating a full and useful result, which the second claim has not.

THE PATENTEE, NOT THE PUBLIC, IS RESPONSIBLE FOR THE WORDING OF THE CLAIM AND HE AND NOT THE PUBLIC MUST SUFFER IF IT IS DEFECTIVE.

Claims are required by the Statute. They are necessary in order that the metes and bounds of a patent may be defined with clearness, that the public may know what is protected and what is free.

This case develops no equities requiring a departure from the ordinary rules governing the treatment of patents and patentees.

Westinghouse was an old inventor, a veteran patentee, of ample means and favored with the aid of experienced counsel and solicitors. Everything done in obtaining his patent was with eyes wide open and under the fullest advice. In pressing the second claim he simply overreached as did Morse with his eighth claim.

If the second claim were the only claim of the patent the Court might possibly, in their anxiety to prevent an entire loss of the invention, construe the claim, by narrowing it, so as to include, under the terms "*substantially as set forth*," the additional auxiliary-valve device described and shown in the specification and drawings. This would have been going to the

very verge of liberality. But no such exigency, no such necessity exists. There are, as we have seen, other claims in the patent which fully cover the structure which the patentee has actually shown and described, and it would be a vain thing, as well as repugnant to all settled rules of construction, to interpret the second claim, for the mere purpose of saving it, *to mean the same thing as some other claim.*

Who should suffer from this faulty claim—the patentee, who drew it, or the Defendants, who had no hand in its preparation?

Complainant admits that it is defective, but asks the Court to construe into it *just enough* to hold the Defendant's device, which does not embody the elements of the other claims, but *not enough* to make it open to the objection of being the same as the other claims.

This Court will not adopt any such elastic construction of plain language. They will rather reiterate what they said in *White vs. Dunbar*, 119 U. S. 47, where, speaking through Mr. Justice Bradley, they said:

“Some persons seem to suppose that a claim in a patent is like a nose of wax, which may be turned and twisted in any direction, by merely referring to the specification, so as to make it include something more than or something different from, what its words express. The context may, undoubtedly, be resorted to, and often is resorted to for the purpose of better understanding the meaning of the claim; but not for the purpose of changing it, and making it different from what it is.”

“The claim is a statutory requirement, prescribed for the very purpose of making the patentee define precisely what his invention is; and it is unjust to the public, as well as an evasion of the law, to construe it in a manner different from the plain import of its terms.”

MELVILLE CHURCH,
Of Counsel for Defendants.



For Nos. 403 and 426.

Brief of Fenton, Hill & Church for
Supreme Court of the United States.

October Term, 1896. Nos. 403 and 426.

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BOYDEN POWER BRAKE COMPANY,

GEORGE A. BOYDEN, President.

CHARLES B. MANN, Secretary.

WILLIAM WHITRIDGE, Treasurer.

AND

BOYDEN BRAKE COMPANY,

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Appellees.

Office Supreme Court, U. S.

FILED.

FEB 25 1897

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CROSS-APPEAL.

BRIEF OF
RE-ARGUMENT
FOR BOYDEN BRAKE CO.

MELVILLE CHURCH,

HECTOR T. FENTON,
LYSANDER HILL,
Solicitors for the Boyden Brake Co.

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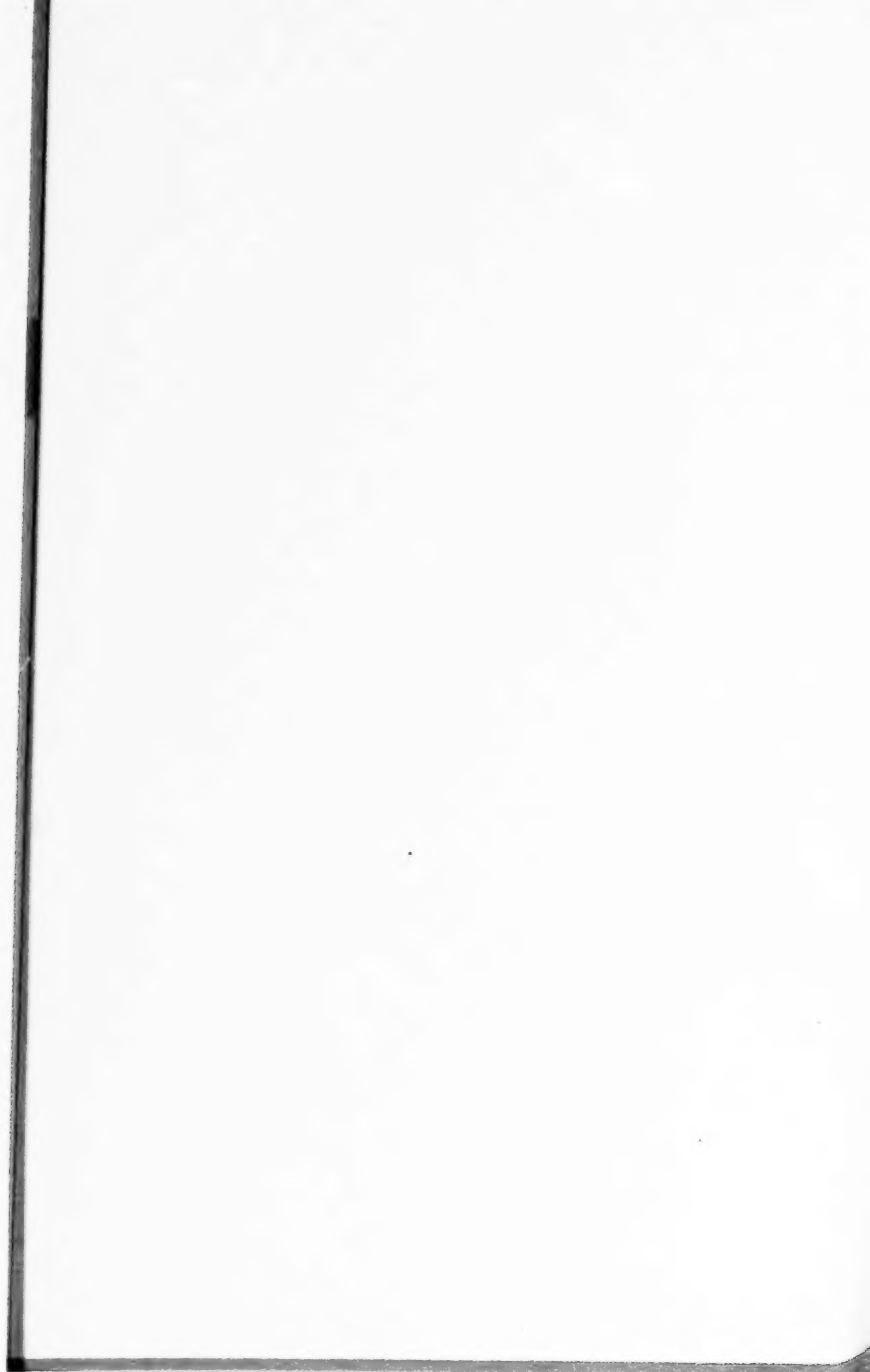
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Supreme Court of the United States.

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CROSS-APPEAL.

NOTES OF RE-ARGUMENT,

BY

MR. FENTON,

ON BEHALF OF THE BOYDEN BRAKE COMPANY.

The record in this case discloses that the appellate decree complained of adjudicated a single issue of fact. The patent in suit was not attacked for want of novelty, nor is it alleged to be invalid in any respect under proper construction of its claims, nor is there any valid ground for dispute in that regard except as to the *second* claim. There is no REAL controversy involved in this case except the single question of whether the two machines of the parties appellant and appellee (which are admittedly widely different in *mechanical* construction), are or are not identical in *principle* of construction and operation,

or whether (as we contend and as both courts below have adjudged) they are constructed and operate on radically different principles. Of course the interpretation of the disputed claim 2 is necessarily incidently involved under such an issue of fact, but that is true of such an issue in every patent cause.

An Analysis of the Plaintiffs' Assignments of Error.

The assignments of error set forth on pages 2 to 4 of the Westinghouse principal brief, are seven in number. Not a single one of them except the 6th and 7th (which are practically the same and relate to the findings of the Court under the issue of infringement), raise any question decisive of the single and only issue involved in the cause. Of the remaining assignments of error, the *first* sets up an alleged conflict of decision between the appellate tribunals in the Second and Fourth Circuits; the *second* alleges that the Court of Appeals adjudicated the second claim of the patent in suit to be invalid; the *third* alleges error in giving improper effect to the defendants' patent as a piece of evidence; the *fourth* alleges error in law in the effect given to the term "substantially as set forth" in construing the claims; and the *fifth* avers error in the effect given to the file and contents of the application for the patent in suit.

It is proposed to direct this argument principally to a brief review of the errors assigned and to show their immateriality, leaving to my colleague to present a more extended argument differentiating in detail the machines of the parties, showing also the evolution of each of them and demonstrating their radical differences in principle.

1. As to the alleged conflict of decision between the appellate tribunals in the Second and Fourth Circuits in respect of the validity of claim 2. Of course this allegation presupposes that they both passed upon the same question arising upon the same or analogous premises. They did nothing of the kind.

Neither of them passed upon an abstract question. Neither of them construed claim 2 regardless of the character of the alleged infringing device which it was charged infringed it. The two tribunals had before them, respectively, two totally different structures alleged to infringe. The defendants' device (N. Y. Air Brake Co.) before the Court in the Second Circuit, was an obvious infringement; and it was equally obvious that the defendants' (Boyden) device before the appellate tribunal in the Fourth Circuit was not. So much was this the case, that the defendants in the Fourth Circuit asked the Court to apply the interpretation of the 2d claim as adjudicated in the Second Circuit. There is not necessarily any conflict of decision as respects the validity and scope of a patent claim, merely because as between two alleged infringing devices, one is held to infringe the claim and the other is not.

This alleged conflict of decision can be disposed of very briefly. It has been fully discussed in my printed brief heretofore filed (see pages 21 to 26), to which special reference is requested. It is not proposed now to take up time by discussing the propriety or correctness of dicta appearing in the opinion of either Court. Faults in that respect may doubtless be found in both. We are to consider only the correctness of the matter *adjudicated*; not mere isolated inartificial expressions occurring in the opinions of the respective Courts. Whether or not there may be paragraphs which, considered apart from the whole, are open to criticism, is not of the least importance *in the decision of this case in this court*, if we can gather from the whole opinion of the Appellate Court below that it *adjudicated the single issue* in the case *correctly*. This appeal is taken to review the *decree* of the Court below, not mere dicta in its *opinion*.

If, however, we look to the opinion to ascertain on what conclusions the decree is founded, a single reference will be sufficient to demonstrate beyond any doubt that the decree was right. The Court of Appeals, whether it meant to hold claim 2

invalid under the doctrine of *Morse vs. O'Reilly*, certainly did not rest its adjudication thereon, but disposed of the case on a different ground, because, after discussing claim 2, it gave effect to it as a valid claim by stating in substance that its concluding words, "substantially as set forth," implied the presence of the elements necessary to perform the function recited in the claim, but did not confine the claim to the particular construction of these elements. These two propositions appear very clearly from the opinion (see R., p. 878, folios 1416 and 1417), in which the Court said:

Folio 1416—

"These words ('substantially as described') limit the "general terms of the specification which set out the "*function* * * * to his own means or their *mechanical equivalent* for performing the function."

Folio 1417—

"The question at bar is whether Boyden's (quick-action improvement on the triple-valve of the old patent, 220,556) "is the mechanical equivalent of Westinghouse's (quick-action improvement on the triple-valve of his old patent, 220,556). * * * They seem to us to differ "as widely from each other as two devices for accomplishing the same result can well differ." (R., p. 880, l. 30.)

Thus showing that the Court of Appeals, notwithstanding what it said in just criticism of the form of the claim, actually rested its decision upon two propositions: 1st. That the "*question at bar*" was whether or not the machines of Boyden and Westinghouse were the "mechanical equivalents" of each other; and, 2d, Finding, on comparison, that they were radically different from each other.

If these two quotations do not show conclusively that the Appellate Court rested its decision solely on the radical differences in principle between the two machines, there is no force in English words.

There was no effort made or argument advanced by the Boyden Brake Company in the Court of Appeals to dispute, qualify

or limit the scope or effect of the decisions in the Second Circuit as *res judicata* on the construction of the claims; but, on the contrary, we relied upon and urged upon the Appellate Court in the Fourth Circuit that the construction and interpretation of the plaintiffs' patent, and especially of claim 2 thereof, by Judge Lacombe (65 Fed. Rep., 99, affirmed on appeal), was correct; and that, if accepted as correct and followed by the Court of Appeals in the Fourth Circuit, it required that the latter tribunal should reverse the decree entered by the Circuit Court in the case at bar, which construed the claim 2 aforesaid very differently and inconsistently with the construction given to it in the Second Circuit; and this I shall endeavor to clearly demonstrate in its appropriate place in this argument.

The radical differences between the devices of the respective defendants in the two circuits is clearly pointed out in the opinion of Judge Hughes.

On the subject of the effect of the decision of Judge Lacombe, alleged by the Westinghouse counsel to be *res judicata* on the same question before the appellate tribunal in the 4th circuit, the learned Judge in the latter court stated the difference between the two questions before the two respective courts in the following words (R., p. 883):

"Here it is contended (by plaintiffs) that the mere use of the extreme traverse of the triple-valve piston to effect the same *functional* result which was effected by Westinghouse in 360,070, constitutes an infringement, irrespectively of the additional means employed. There it was ruled that the use of the extreme traverse and of an additional machine attached to the original 220,556, which was structurally and *mechanically* equivalent to 360,070, was an infringement of the latter patent. The cases are different, and not on all fours."

The learned Judge (Hughes) was entirely correct in that statement. The defendant's machine before the New York court (as shown opp. R., p. 883), contained an "auxiliary" valve and a

segregated passageway controlled by it; and Judge Lacombe found infringement (see 65 Fed., p. 101), because of the presence in **that** defendant's machine of a "triple-valve" **and** an auxiliary-valve device, independent of the "main valve"; adding in substance (page 102 of report) that claim 1, which includes these elements, does not differ from claim 2 (here under discussion), except that the latter is even more limited—*i. e.*, that "it is to be by a further traverse of the piston." And this is the sole distinction which differentiates the two claims. Obviously there is no conflict of decision between the two courts on the same *question of the construction of claim 2*. The pretence that Judge Hughes' remarks on the invalidity of functional or result claims, constitutes such a conflict, is without foundation, when it is seen that the "question at bar," as stated by the court in the 4th circuit, and on the adjudication of which the decree of reversal was rested, was whether or not, under the same interpretation of the claim 2 as stated by Judge Lacombe, the machines of the parties in the case at bar were or were not *mechanical* equivalents; and he held, and properly held, that they were not. (See insert illustrating the three structures.)

2. As to the alleged errors set forth in the third assignment of error, what matters it, whether the learned Judge who wrote the opinion of the Appellate Court in the Fourth Circuit was right or wrong in saying that "the Patent Office employs the best experts in mechanics which it can secure in this and other countries." Is the time of this Court to be wasted in deciding that moot question? If it has any materiality at all it is presumably true, no matter what the actual fact may be, as the statute requires the Commissioner to appoint an examining corps skilled in the arts and does *not* require him to confine his appointments to citizens of the United States. The second branch of this assignment is without merit, for the language criticised is a paraphrase of a sentence correctly

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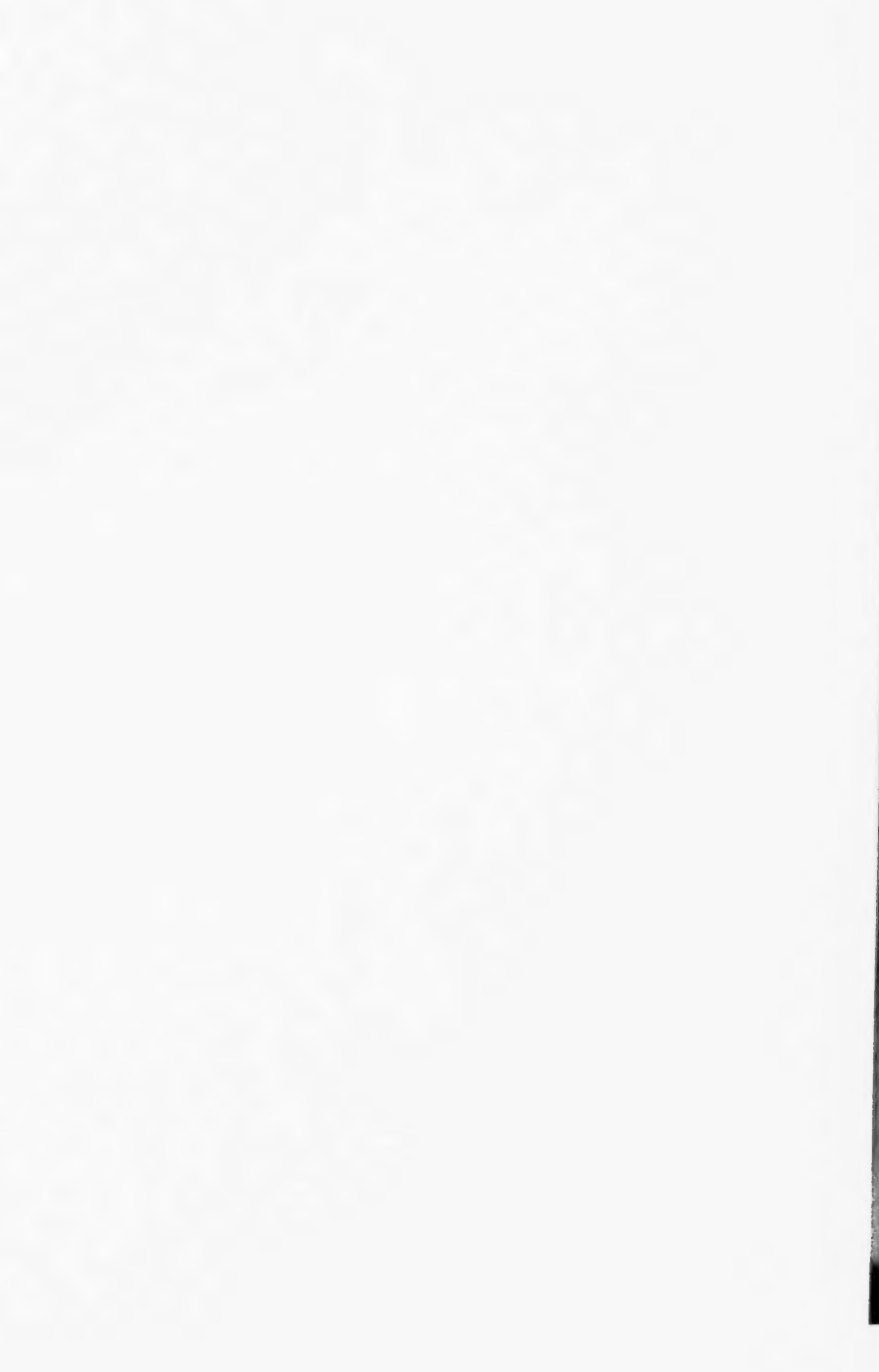
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used by so eminent a patent jurist as the late Justice Bradley, in *Burns vs. Meyres* 100 U. S., 671 (672). The third and fourth branches of this assignment of error are not well founded because it is too well settled in this Court to be open to dispute at this late day, that the action of the Patent office in awarding a patent to the defendant is evidence of some considerable weight that the thing described and claimed therein is not identical with the subject matter of a prior patent, especially where such prior patent was called to the attention of the Commissioner and actually considered by him in passing upon the novelty and patentability of the later device. *Miller vs. Eagle Co.* 151, U. S. 186 (208). The reason of this rule of evidence is clearly stated in *Corning vs. Burden*, 15 Howard 252.

3. As to the fourth assignment of error, it is respectfully submitted that the Court below was not only substantially correct, but absolutely accurate in its definition of the term "substantially as described."

The Court said (see R., p. 878, folio 1416); "These words limit the general terms of the specification which set out the *function* performed by the invention and confine the inventor's rights to his own *means*, or their *mechanical equivalent* of performing the function." No possible objection can be successfully made to this strictly accurate and broad definition.

4. The matter of the fifth assignment of error relating to the effect of the file wrapper and contents of the application for the patent in suit, in the interpretation of the claim, will be discussed more fully hereafter in the brief argument which I shall make on the construction of the claims.

In approaching the consideration of this single issue of non-infringement, we may first refer to three potential propositions, none of which can be successfully disputed:—

1. The two machines of the parties litigant are obviously and admittedly as widely different in mechanical construction as two things to produce the same result can possibly be.

2. The fact that two devices produce and are intended to produce the same result, does not establish that they are alike in principle, nor is it even *prima facie* evidence thereof.

3. That the burden of sustaining the affirmative of the issue of infringement beyond any reasonable doubt is upon the plaintiff, and that this burden is not discharged merely by showing that two machines were designed to produce or do in fact produce the same result, if upon the plaintiffs' proofs comparing the two mechanical devices structurally, the question of identity or non-identity in principle of construction and operation is left open or qualified by the least conjecture or doubt.

The Defendants' Patents and Their Effect as Evidence Under the Issue of Infringement.

The radical differences in principle between the plaintiffs and defendants machines, are fully described in three patents to defendants, differentiating the device from the plaintiffs invention of the patent in suit, and containing grants to defendants of claims of such breadth and scope as to be utterly inconsistent with the theory that the defendants' machine is at all alike to the plaintiffs in principle.

The record contains evidence showing the evolution of the defendants' device which is alleged to infringe. The device, as admitted, is the structure described in the patents granted to Boyden August 16, 1892, Nos. 481,134, 481,135 and 481,136. Application was filed in the Patent Office for one of these September 30, 1889, before this suit was brought.

They all retain the essential underlying principle of the previous Boyden 1883 patent (R., p. 498) in that they provide means to convey *train-pipe air* to the brake-cylinder *through the triple-valve-chamber* (and not through any separate and independent passageway) the said machines retaining all the usual parts and functions of a triple-valve per se. The means (patented by Nos. 481,134, etc.), for performing the additional function

referred to are shown in a diagram opposite page 14 of my former brief, and so fully described, discussed and compared with the complainants' device that it is not necessary now to reiterate.

The proposition now to be discussed is the legal effect of this differentiation, which is found expressed on the face of these later Boyden patents, and the broad claims allowed for this distinctively different and novel device.

The reason for the usual exclusion of such evidence is founded on the theory that a posterior patent could not justify an infringement of a prior one *for the same invention*.

The posterior patents are not set up in this case as being for the *same invention* as the plaintiffs', but as evidence that the defendants' device, described and claimed in it, *differs essentially, quoad* the part or improvement claimed in the prior patent, from the machine of such prior patent.

These patents show by their descriptive matter and by their claims the *quasi* judicial finding of the Patent Office, that the device described and claimed in the later patents to defendants is not the mechanical equivalent for, or an improvement on, the device described in the earlier patent of complainants, and that the devices of the two patents are for *distinct and different* inventions, constructed and operating on different principles, though both producing the same result.

The question is presented in the case at bar under the third assignment of error and the argument on it in the Westinghouse brief (see page 3 pages 83 to 91). In the case at bar the Circuit Court practically refused to give any weight whatever to these patents as evidence for the purpose for which they were introduced, on the ground that the Patent Office was "unassisted by testimony as to the state of the art at the date of the Westinghouse patent, and without testimony as to the scope of the Westinghouse quick-action invention." (See Record, page 852.)

This is a new doctrine without precedent. It is no part of the duty of the Patent Office to take *testimony* as to the state

of the art or as to the scope and importance of an invention. When an application such as Boyden's was filed it was the duty of the Commissioner to consider the patent here in suit as part of the prior art, to determine whether or not they were for the same invention in whole or in part, or whether they were for different inventions constructed and operating on different principles.

Presumably the Commissioner did his duty, and the record in this case shows that he did so in fact. The Court of Appeals, however, correctly gave due and proper weight to the defendants' patents as evidence of non-identity. That Court did not decide that the Patent Office had passed upon the question of "infringement" in the narrow sense pretended in the Westinghouse brief, but distinctly held that the ruling of the Patent Office in granting the defendants' patents was prima facie evidence of non-identity, and distinctly said also that this ruling was not conclusive, but was entitled, however, to great respect and to have due weight given to it. This ruling was absolutely correct, as will appear by reference to *Miller vs. Eagle Co.*, 151 U. S., 208, which affirms Mr. Justice Grier in *Corning vs. Burden*, 15 How., 252. The latter case discusses this question so fully that we ask special attention to it. Mr. Justice Grier calls our attention to the fact that since the patent act requiring examinations of applications as to novelty, the grant of a patent to the plaintiffs is prima facie evidence of novelty. The learned Judge said that in cases of doubt the defendant is equally entitled to the same presumptions arising from the grant of a patent to him. Practically applying the rule in *Brooks vs. Bicknell*, 2 McLean, 432, Justice McLean said that under the issue of infringement, where the evidence is evenly balanced, the burden of proof being on the plaintiff, if the defendant has a patent for the device used by him which is not a mere improvement upon the plaintiff's, the defendant's patent is sufficient to turn the scale in his favor, under the issue of

infringement, or even to resolve a *doubt* in the same way (if there be a doubt) under this issue. (See also *New Mfg. Co. vs. Superior Co.*, 56 Fed., R., p. 152.)

An examination of the patents granted to Mr. Boyden for this ingenious invention, Nos. 481,134, 481,135 and 481,136, will show that he therein fully set forth the principle of his invention and clearly distinguished it from that of the patent in suit. We call attention especially to the following extract from the specification (R., p. 805, l. 3, of his patent, No. 481,134), which was filed in the Patent Office *before* this suit was brought (the italics being our own), viz:

"Efforts have been made heretofore to combine with a
 "triple-valve certain *additional* mechanism by which
 "train-pipe air could be introduced directly into the
 "brake-cylinder in effecting the application of the brakes
 "for emergency stops; but in every such instance a *sup-*
 "*plemental passage* or passages together with a *supple-*
 "*mental* or *auxiliary* valve, has had to be employed in
 "connection with the triple-valve proper, in order that
 "the ordinary functions of the triple-valve might be pre-
 "served and the additional function of introducing train-
 "pipe air into the brake-cylinder for emergency stops
 "be combined therewith." "An example of the class of
 "valves referred to in the last preceding paragraph which
 "employ an auxiliary-valve, combined with an ordinary
 "triple-valve, is shown in United States patent to George
 "Westinghouse, Jr, dated March 29, 1887, No. 369,070."

"It will be seen that my present invention for introduc-
 "ing train-pipe air into the brake-cylinder for emergency
 "stops differs essentially from the device shown in the
 "said Patent No. 369,070, because I have provided a *new*
 "*principle of construction* and a *new mode of operation*
 "by use of which the desired result aforesaid may be pro-
 "duced *without the aid of the auxiliary-valve heretofore*
 "*required for the purpose.*"

It will be seen that the above extracts fully distinguish the Boyden invention from that of the patent in suit, and, by

granting the patents to Boyden containing these statements, and broad claims based upon the novel device thus differentiated, the disinterested and experienced experts in the examining corps of the Patent Office signified their full recognition of the facts stated, which accord in all respects with the position taken in this suit by the defendants' experts.

A casual glance at claim 1 (R. p. 806) of defendants' patent 481,134 to Boyden, will disclose, in a condensed statement therein, how it differs in principle and operation from the patent in suit. The Patent Office was obliged to consider the question of novelty, in a patentable sense, of Boyden's device as compared with that of the patent in suit. Its decision in favor of Boyden, by the grant to him of these patents, raises a strong *legal* presumption of *non-identity* heretofore referred to in the authorities cited, and is quite sufficient to turn the scale in his favor on the issue of infringement when, on comparing them with the prior art, it is seen that they are *independent* improvements upon the prior "triple-valve", and not a mere improvement on the patent in suit.

In *Morgan vs. Daniels*, 153 U. S., 120, this Court said (p. 123):

"The grant of letters patent is *prima facie* evidence
 "that the patentee is the first inventor of the device
 "described in the letters patent and of its novelty (*Smith*
vs. Goodyear Co., 93 U. S., 486). Not only is the burden
 "of proof to make good the defense (of want of novelty)
 "upon the party setting it up, but it has been held that
 "every reasonable doubt should be resolved against him."

In *Morgan vs. Daniels* the suit was brought under Sec. 4915, Rev. Stat. by the unsuccessful party in an interference before the Patent Office, against the successful party, alleging that the decision of the Office was wrong and that the plaintiff was really the first inventor of the device in controversy. This Court held, as succinctly and correctly stated in the syllabus—

"When the question between the contending parties as
 "to priority of invention is decided in the Patent Office,

“such decision so made must be accepted as controlling
 “upon that question of fact in any subsequent suit
 “between the same parties, unless the contrary is estab-
 “lished by testimony which in character and amount
 “carries thorough conviction.”

The Court also said that the rule quoted as to the burden of proof under the defense of want of novelty is applicable to a controversy in the courts between a successful and an unsuccessful party to an interference case previously decided in the Patent Office, the language of the Court being as follows :

“These two cases are closely in point. The plaintiff in
 “this case, like the defendant in those cases, is challeng-
 “ing the priority awarded by the Patent Office, and
 “should, we think, be held to a strict proof,”

the Court adding that this rule is more stringent even than the rule applied by the Court below, as stated by it in the following words :

“The complainant on the issue here assumes the burden
 “of proof, and must, I think, as the evidence stands,
 “maintain it by a clear and undoubted preponderance of
 “proof.”

In *Morgan vs. Daniels* this Court further added the following remarks, which are pertinent to the case at bar and refer to—

“the rule which controls a chancellor in examining a
 “report of a master, or to an appellate court in reviewing
 “findings of fact made by the trial court. There is always
 “a presumption in favor of that which has been once
 “decided, and that presumption is often relied upon to
 “justify an appellate court in sustaining the decision
 “below.”

See *Crawford vs. Neal*, 144 U. S., 585.

Camden vs. Stuart, 144 U. S., 104.

Furrer vs. Ferris, 145 U. S., 132.

The reasoning in the opinion in *Morgan vs. Daniels* points out the decided tendency of the courts to sustain departmental decisions on questions of fact, and to hold them as conclusive and final in the absence of testimony sufficient to produce a clear conviction that the Patent Office or the departmental tribunal erred in its conclusions of fact; and that the burden of so proving is upon the party controverting the departmental decision, and that such party must establish the error beyond any reasonable doubt.

If this is the rule applicable to cases in which a defendant, under a plea of want of novelty, attempts to overcome the prima facies of a patent, or when the plaintiff in a suit under Sec. 4915 attempts to overcome a decision adverse to him in an interference before the Patent Office; or is the rule in a suit to set aside a judgment (as in *Butler vs. Shaw*, 21 Fed. Rep. 321), or in a contest between two claimants for land patented by the United States to one of them (as in *Johnson vs. Towsley*, 13 Wallace 72), very much more pertinent is the rule to the case at bar in which (apart from the evidence showing a decision of the Patent Office on the issue of identity of construction, in favor of the defendant by the grant of a broad patent to him), the burden of proof is upon the plaintiff upon the same identical question under the issue of infringement which he tenders by the allegation of his bill of complaint. In other words, the burden of proof to sustain the charge of infringement is in every case upon the complainant and this burden is not discharged by evidence of a character which leaves the question uncertain or doubtful. But even if the testimony offered under such an issue in the Courts is sufficient to create a probability that the affirmative of the issue is true, then under the rules laid down in the cases cited, this effect of the evidence is entirely rebutted and wholly overcome and the burden of proof shifted, by proof of a decision by the Patent Office Department deciding the identical question by a grant to the

defendant of a patent for the identical machine in controversy, especially when, as the record discloses in this case, it was so decided after consideration of the plaintiffs' patent charged herein to have been infringed. The rule in *Morgan vs. Daniels* has been recently applied in *Cartridge Co. vs. Peters* by the Court of Appeals in the Sixth Circuit, 78 O. G., 621, in an able opinion by Judge Lurton delivering the unanimous opinion of the court, in which the learned judge said, in concluding his opinion, that—

“the complainant has not produced that thorough conviction that he is the first inventor of these improvements, which he must do to justify a decree annulling the deliberate and well-considered action of the Patent Office. * * * There are many inexplicable things tending to cast a doubt as to who was the first inventor. * * * On the whole case, however, we lean to the correctness of the judgment of the Circuit Court and of the action of the Patent Office. This mental attitude is one which requires that the decree of the Circuit Court shall stand.”

This doctrine, however, is not new. It is fairly inferable from the reasoning of Judge Clifford in *Corning vs. Burden*, 15 Howard, 252, and of Justice McLean, on circuit, in *Brooks vs. Bicknell*, 2 McLean, 432.

As, however, the decision of the Patent Office is not conclusive, though presumptively correct and decisive in the absence of evidence which fully meets and rebuts it, the court is, therefore, brought to consider and weigh the evidence for and against the correctness of the decision of the departmental tribunal.

A Brief Comparison of the Plaintiffs' and Defendants' Machines.

Let us disregard form and look only at the principles of construction and operation of the two machines respectively, keeping in mind at the outstart the fact—essential to a correct conclu-

sion—that both parties utilize and retain, as a distinctive element in their respective combinations of mechanism, a “triple-valve,” such as shown in patent 220,556 and other prior patents. Both have *now* produced a quick-action machine, evolved from these prior devices; and in such new machine of both parties, the mechanism necessary to perform *all the old triple-valve functions*, are substantially identical, and these are old, and these the world has a right to use, and these remain in *both* the machines of the plaintiff and defendant respectively and operate to perform their usual functions as *triple-valve* mechanisms. They have not been altered or added to in any respect to change or qualify their triple-valve functions in either machine. The mere fact that both parties desired to produce the same additional result, and that both succeeded in that respect, is not of the least importance in determining the question at bar. What we wish to know is, whether or not each party added mechanism to the old device, which produces the new result *in the same way* and by *analogous means involving the same principles* of construction and operation. If they did not, there is no infringement, even though their respective devices produce identical *results* and are *functional* equivalents in that respect.

Recalling to the mind of the Court that the plaintiffs' machine consists of “additional members,” as he calls them, “combined” with the old triple-valve of his prior patent, 220,556, forming two machines in one casing, (the old machine venting auxiliary-reservoir-air as before, and the new or added machine venting only train-pipe air *without passing such air through the old machine*) we find by comparison therewith that the defendants' machine does *not* consist of “additional members” added to the old triple-valve, and thereby constituting *two* machines combined, but it consists of *one* machine, and that the old one, improved, and improved in a part which never before by any one in the world was ever thought could be improved or modi-

fied, viz., by separating the triple-valve chamber into two chambers communicating with each other through a restricted opening; in plain words, inserting a *bushing* or *partition* therein, and so producing differential pressures in the chamber on either side of said partition, by which the *old main-valve* of the triple-valve is made to simultaneously vent both auxiliary-reservoir air and train-pipe air to the brake-cylinder.

This was a great invention by Mr. Boyden. It was a discovery; a revelation of the latent powers of the old machine, made wonderfully effective by the most simple change, and in a part of the device never before attempted to be modified, and which the skill of the mechanic would never suggest to him to alter, add to or modify to produce the effect sought for. The means adopted to produce the effect obtained, *i. e.*, differential pressures, producing the desired effect, could never be *reasoned* out from anything then known in the art; certainly not from anything contained in the plaintiff's patent. It was a most ingenious invention, simple though it is, and the widest possible departure from the principle on which 360,070 is constructed.

No one skilled in the art or otherwise could, from anything contained in the plaintiff's patent, construct or evolve such a structure as Boyden's. The patent in suit does not teach the principles—much less the mechanisms—contained in defendant's machine, and it was never *intended* to teach it, or anything even remotely resembling it, either in construction or operation.

No person, with an understanding of the patent in suit, can logically contend that Westinghouse meant, by anything said therein, to include a triple-valve device in which the *main valve* of such was made to *vent train-pipe-air* or to vent it through the *triple-valve-chamber*, and any person attempting such a change, without also combining with it Mr. Boyden's partition in the valve chamber, would make an inoperative structure that would be worse than useless.

In other words, if we abandon the principle of segregated machines, as defined by Westinghouse patent, we *must* apply the Boyden principle in the reconstruction of the valve-chamber.

This is a leading, forceful and predominant *fact*, and it governs the decision of the question of identity or non-identity.

**The Construction of the Patent in Suit is to be
Qualified and Not Broadened, by Reason
of the Fact that the Device, However
Meritorious in Theory, is Not in
Practical Use.**

Confessedly the invention of the patent in suit, as shown and described therein, is not now made and sold by the plaintiffs, and has not been since 1887 or 1888. (Record, p. 149, line 36.) The reason for its abandonment appears clearly from the evidence in the record (page 126, line 6), and from the remarks of the judges in the New York cases (59 Fed., 594, affirmed, 63 Fed., 962-969); and although it is an operative device, it did not meet the public demand *without the improvements afterwards patented* in Westinghouse's later patent, 376,837. The defendant (Boyden's) device, on the other hand, admittedly operates as efficiently as the *latter*, and is not open to the objections to the former (360,070). The plaintiffs' contention, therefore, seeks to broaden the scope of a *paper* invention, and of the indefinite claim 2 of the patent therefor, to repress a mechanically different thing with which it cannot successfully compete.

In *Long vs. Pope Manufacturing Co.*, 75 Fed. Rep., 635, where the bill was dismissed by the Circuit Court in a case for alleged infringement of a patent which the plaintiff sought to broaden by construction to include the defendant's device, the Court of Appeals, in the First Circuit, in an able opinion by Judge Putnam sustaining the decree below, said:

1. "This patent was taken out in 1862, and, so far as it comes in issue here, it has not been put into practical

"use. Therefore, in determining the inventor's conception of the functions of the claims in issue, of the condition of the art, and of the improvement which he gave to the public, our safest resource, after so long a lapse of time, is the patent itself." * * *

2. "If the functions of the invention were solely those stated in the specification, the claim must clearly have a narrow range, while if the other function now suggested is permitted to aid in controlling its construction, it is entitled to a broad one. It is plain, nevertheless, on all rules, that so much of the mere form given in the specification, drawings and claim, is essential and must be retained, as is necessary in order to accomplish all the functions expressly enumerated therein. * * *

"A function afterwards discovered cannot be used to broaden it, and such a function is available to the patentee only when the patent, construed in the light of the circumstances existing when it is applied for, is broad enough to embrace it. In the case at bar there is nothing to show that the function now claimed for the invention was in the mind of either the inventor or of the Patent Office when the patent issued." * * *

3. "If this invention had been put in early use, and so continued with a long public acquiescence, it might perhaps have safely received therefrom a practical construction more favorable to the complainants. But in view of the rapidity with which mechanical improvements advance in this age, it would be a dangerous precedent to give to a mere paper patent, which has lain dormant for years, a breadth not contemplated on its face by reason of some new function discovered long after its issue, and after that function had been availed of in practice by others. There appear in this case some elements which perhaps would render it not inequitable to permit that result here; but the precedent, if established, would, on the whole, operate more to entrap honest manufacturers than to advance the useful arts."

The principles stated in the foregoing opinion (which has been divided into paragraphs for convenience of comparative reference) are applicable to the case at bar. The device described in the Westinghouse patent in question, has admittedly not been manufactured since it was superseded by the improvement thereon described in the later Westinghouse patent No. 376,837 issued in 1888; it admittedly contained defects which the latter remedied, and which superseded it. This is so clearly shown by the evidence in the Record, and by the opinions of the New York courts that it cannot now be successfully explained away or controverted. Against the principle stated in paragraphs 1 and 2 above, it is sought now by the plaintiffs to give to the machine, through its piston, a new function not contemplated by the inventor nor disclosed in the patent. As said by Judge Putnam, "so much of the mere form given in the specification, drawings and claim is essential, and must be retained, as is necessary in order to accomplish all the functions expressly enumerated therein." Hence, if the plaintiff's contention is correct, that the invention is broad enough in scope and intention to include dispensing with the auxiliary valve and giving the main valve the additional function of admitting train-pipe air, by reconstructing the valve-chamber of the triple-valve element of the combination, or is broad enough to dispense entirely with the segregated passage-way, "directly admitting train-pipe air to the brake-cylinder by utilizing the valve-chamber of the 'triple-valve' element of the combination for that purpose, or is broad enough to include a combination with the 'triple-valve' element of the claim, of "a device for admitting air *directly* from the main-air-pipe to the brake-cylinder" (the rejected and erased claim), or is broad enough to cover, not a combination with the triple-valve element of some *added* part or parts (through which the train-pipe air is vented), but a device which consists solely of a reconstruction of the triple-valve element itself and not employing any of the 'additional

members' described in the specification or any substitute therefor, and which 'triple-valve' element retains all its old valves which also retain all their old triple-valve functions of admitting reservoir air, but perform an additional function, not because of any change in them but solely because of a restricted partition in the valve-chamber of the "triple-valve" element, it is very certain that the patent does not disclose in its specification and drawings as part of the invention, this giving of a new function to the old valves of the "triple-valve" element, and which, as Judge Putnam remarked in *Long vs. Manufacturing Co.*, under similar circumstances above referred to, had been discovered and put in practice by these defendants *after* the issue of the patent in suit, and which would be giving to such patent a breadth not contemplated on its face, as inclusive of an invention not in the mind of the inventor when he made his application, and a scope not contemplated by the Patent Office in the consideration and allowance of the claims in controversy, and finally as establishing a precedent which, as Judge Putnam said, "would operate more to entrap honest manufacturers than to advance the useful arts."

The Construction of the Claims as Deduced from the Face of the Patent.

The patented mechanism consists of a brake device, having for its foundation or principal element in the new combination a triple-valve device such as described in the Westinghouse patent No. 220,556. This device operated to admit air pressure to the brake-cylinder solely from the auxiliary-reservoir. To this device, as so constructed and operated, and without any material change therein, either in its parts or in the mode of operation of any of its parts, or in any of the triple-valve functions performed thereby, the patentee of 360,070 (the patent in suit) *added* two elements, viz, an auxiliary-valve (marked 41)

and a passageway (marked 46) controlled thereby. This valve 41 was purely *auxiliary*, not only in mechanical construction and mechanical operation, but in the function performed thereby; hence (as stated in the patent) it was *independent* of the main valve, and could be plugged up without in any manner affecting the action of the triple-valve, or any of the ports or passages of the latter, and necessarily, in a machine constructed on that principle, the passageway 46 is separate from the triple-valve proper and leads *directly* from the train-pipe to the brake-cylinder.

From the patent in suit we extract the following:

"So far as hereinbefore described, the triple-valve
 "accords in all substantial particulars with, and is adapted
 "to operate similarly to those of my letters patent Nos.
 "168,359, 172,064 and 220,556, and in order that it may
 "perform the further functions requisite in the practice
 "of my present invention, it is provided with certain
 "*additional members.*"

No one can read the specification of the patent in suit without reaching the conclusion that the *essence* of the invention consists in combining *two separate and distinct* machines, in such manner that the old one will, under certain circumstances, *i. e.* when quick action is desired—bring the new one into action, *which latter performs no function whatever of the old triple-valve machine.*

We shall not take up the time of the Court discussing the question of pioneer patents and rules for considering claims therein. It is sufficient to say that under the decisions of this Court (notably *Morley vs. Lancaster*, 129 U. S., 263), no matter whether the *function* performed by the new mechanism is entirely new or not, and no matter how broad is the range of equivalents to be permitted in determining identity of mechanisms, it cannot be, and never has been, sanctioned by this Court that a defendant's device infringes such a patent, even if it perform precisely the same functions, unless its *mechanism* is constructed and operates on the *principles* disclosed in the patent

in question. Indeed this Court has distinctly said so in *Morley vs. Lancaster* in these words (see page 266 of the report).

“The Morley claims are not for a result or effect, irrespective of the means by which the effect is accomplished. It is open to a subsequent inventor to accomplish the same result, if he can, by substantially different means,”

and affirming (*McCormick vs. Talcott*, 20 How., 402), which was a suit on a pioneer patent, the Court said that mechanism will not be held to infringe it unless it “operates on the same principles and performs the same functions by analogous means or equivalent combinations.” In *Morley vs. Lancaster* the defendant’s machine was held to infringe because this Court found that the mechanical devices used by the defendant were known substitutes or equivalents for devices employed in the patented machine to effect the same result; and this language was used by this Court in defining the term “known equivalent” in reference to a so-called pioneer machine.

Scope and Meaning of Claim 2.

Referring again to the face of the patent in suit, to recall the “additional members” which Westinghouse “combined” with the old triple-valve of 220,556 to make up his invention of the patent in controversy, what construction can we put on the claim 2 in question from the information given by the specification and without other aid?

Let us read it, to be reminded that every element expressed in it, even to the “further traverse” of the piston, is old, both singly and in the same combination, in the old triple-valve of 220,556, the only new thing expressed in the claim being the statement of the *function* of the “additional members.” (See R., p. 468 :

“2. In a brake mechanism the combination of a main-air pipe, an auxiliary-reservoir, a brake-cylinder, and a

"triple-valve, having a piston whose preliminary traverse
 "admits air from the auxiliary-reservoir to the brake-
 "cylinder, and which by a further traverse *admits air*
"directly from the main-air pipe to the brake-cylinder,
 "substantially as set forth."

It cannot be logically contended that the claim is comprehensive of means generally, irrespective of its construction or mode of operation, except that it is brought into action by the "further traverse" of the triple-valve piston. We are obliged to import into the claim *some* means to enable the triple-valve piston to perform this *abnormal* or *additional function*; otherwise the claim read literally would be for an inoperative combination and incapable of producing the desired result. This is true for two reasons: (a) because the function of the triple-valve alone is *not* to admit train-pipe air *directly* to the brake-cylinder, nor is it capable of such action, whether on a partial or a full traverse of the piston; and (b) because the triple-valve proper has no ports or passages leading from the train-pipe side of the triple-valve piston chamber *directly* to the brake-cylinder, and consequently, the triple-valve piston (without such ports) could not be capable of "admitting air directly from the main pipe to the brake-cylinder" by "a *further* traverse," or any other kind of traverse.

If there is any mechanical proposition in this case that is not disputed or open to dispute, it is that the "triple-valve" element of the invention in question, is the *same* triple-valve element of the preceding patents mentioned, nothing more and nothing less, and not performing any new, different or other function, *as such*, than it performed when alone and used simply as a triple-valve. Its piston only co-operates in the device patented, to produce the result recited in the claim, because in the performance of its ordinary, usual and old function, its *further traverse* contacts with and moves a new "auxiliary-valve 41" located in its path in the valve casing, which valve normally

covers a port 42, which opens a passageway 43-46 leading to the brake-cylinder. These "additional members" and the arrangement of them in juxtaposition to or in the path of the triple-valve piston (and wholly disconnected therefrom) in the valve casing, is the entire invention.

Indeed, the patent in suit says so, in those words: because after describing in nearly 2½ pages the construction of the old triple-valve proper, then follows (in exactly 22 lines of the patent, and on lines 5 to 27 of page 466 of the Record) the description, *and the only description in the entire specification*, of the construction of the "additional members" with which the old triple-valve of 220,556, is "provided" as aforesaid. The remainder of the specification is taken up with description of the operation of the device, defining triple-valves, and a disclaimer.

Reasoning by exclusion, it is nowhere shown in the specification, that *other means* than the auxiliary-slide valve 41 and the by-passage 43 and 46 may be employed to carry the air *directly* from the *train-pipe* to the *brake-cylinder*.

Beyond doubt the plaintiff is entitled to a broad claim for *this combination*, covering a wide range of mechanical equivalents, but he is not entitled to such a broad construction as to cover *any* and *all* mechanism involving the principle of admitting train-pipe air direct to the brake-cylinder when the old and usual "further traverse" of the triple-valve piston take place. To so hold would deprive any other person from improving or changing or adding to the old triple-valve of the automatic brake, by mechanism integral therewith, and wholly different in principle of construction and operation from the plaintiff's added elements, which will effect the *same result*. The authorities do not countenance any such theory of construction of patents for inventions, whether correctly classed as pioneer patents, so-called, or not.

Having thus ascertained the nature and scope of the invention, from a reading of the specification, let us see whether or

not our views are corroborated by a reference to the file and contents of the application therefor.

The Scope and the Meaning of Claim 2, as Qualified by the File and Contents of the Application.

The record (see pages 705, 714) discloses that the application, as originally filed, contained a claim and statement which will now be quoted, as they are controlling factors in the correct interpretation of claim 2. This *original* claim and this statement were erased by the applicant after rejection of said claim, and of claim 2 now in issue. The statement erased is as follows (R., p. 714):

"Further, while in the specific construction described and shown the function of admitting air from the main pipe is performed by a valve *separate* from that which effects the preliminary admission of reservoir pressure to the cylinder, a modification in which the same office is performed by a valve *integral* with the main-valve and *formed by an extension thereof*, would be included in and embody the essential operative features of my invention."

The original (1st) claim erased, was as follows :

"1st. In a brake mechanism, the combination of a main air-pipe, an auxiliary-reservoir, a brake-cylinder, and a "triple-valve, *provided with a device for admitting air directly from the main air-pipe* to the brake-cylinder, substantially as set forth."

The effect of the erasure of said statement and claim is, in law, a disclaimer that the valve element of the combination to admit train-pipe air to the brake-cylinder may be *integral* with the main-valve of the triple and merely *brought into operation* by the piston—in fact, it is an implied admission that it must be separate and independent from the main-valve, moved and brought into register with a

separate, independent and auxiliary port and passage-way (wholly disconnected from the triple-valve element) leading through the casing or chest from the train-pipe direct to the brake-cylinder. This view, if it needed any corroboration, is found in the *letter of applicant* to the Patent Office, accompanying his action *erasing said statement and claim*, in which he said (see Record, page 718, folio 1175):

“It is to be understood that applicant does not seek to broadly claim a device for admitting air directly from main-air pipe to the brake-cylinder. * * * When, however, the triple-valve is *provided* with an *auxiliary-valve*, operated by its piston which performs a new function additional to that of the triple-valve as previously employed, it is believed that *such combination* is wholly novel.”

This statement conclusively implies an *auxiliary-valve* in claim 2. But the contents of this file containing this letter absolutely preclude the possibility of construing the allowed claim 2 (allowed *after rejection*, allowed *after erasure* of above broad statement, allowed after erasure of this original first claim, and allowed *after receipt of this letter* defining the invention of *this claim 2* as a “combination” of an “auxiliary” valve with the old triple-valve, the piston or its “further” traverse being the actuating means), as being for *means generically*, operated by the piston of the triple; and which may be *integral* with the main-valve of the triple, or that the Patent Office intended to grant any such claim.

The Circuit Court recognized the force of this, but avoids its usual, proper and required effect by accepting the complainants' proposition, that the aforesaid *statement* in the specification was erased *because the drawings did not show a device which would warrant such a description*; yet that Court says, the patentee may nevertheless claim that his patent covers such a construction if his *invention* is broad enough to include it.

This is a very startling proposition in the law of patents, and remarkable for its novelty and departure from a line of decisions which are too well established to be so easily qualified or overruled. There is no better established principle in patent law at this day than that the doctrine of equitable estoppel is applicable with full force and effect to forever prevent a patentee who has, pending his application in the Patent Office, erased a broad statement of invention and a broad claim founded thereon, whether voluntarily, but more particularly *after* rejection and objection by the Patent Office, as in this case, from ever afterwards asserting for the remaining claims or any substituted claim, a construction or interpretation which shall be tantamount in scope and comprehensiveness to the original and erased statement and claim.

Sheppard vs. Carrigan, 116 U. S. 593.

Sutter vs. Robinson, 119 U. S. 530.

Roemer vs. Peddie, 132 U. S. 317.

Yale Lock Co. vs. Greenleaf, U. S. 554.

Crawford vs. Heysinger, 123 U. S. 589.

Corbin Lock Co. vs. Eagle Lock Co., 150 U. S. 38.

The decision in *Reese vs. Sewing Machine Co.*, 61 Fed. Rep., 958, affords no countenance for any qualification of this salutary rule; besides, the facts in that case have no parallel with those in the case at bar.

Westinghouse's application was filed November 19, 1886, containing the above quoted statement and claim. That erased (1st) claim and the (2nd) claim now in controversy in this case were both rejected. The Circuit Court seemed to think that the prior reference on which the claims were rejected did not in fact operate to negative the novelty of said erased claim, but that the erasure thereof was for the reason hereinbefore referred to. The Circuit Court was entirely in error in this; but whether it was or not is entirely immaterial. The applicability of the doctrine of estoppel is not limited to cases in which the party

happens to rightfully exercise his right of express or implied disclaimer. It is not dependent upon whether his *judgment* was right or wrong, but upon his act. It would be remarkable indeed, if the deliberate act of a party cancelling a broad claim and a broad statement of invention in the performance of a public act of patenting an invention, where his act is purely *ex parte*, could afterwards declare that his act was a *mistake of judgment*, or that it was done for some reason not apparent on the record, and evidence of which rests only *in pais*, and is not accessible to the public. The latter is entitled to be told *plainly* by the record, as Justice Miller said in *Merrill vs Yeomans*, and Justice Bradley repeated in *Keystone Bridge Co. vs. Phœnix Iron Co.*, *what it is that limits its rights* and what exclusive privileges have been carved out and given to the patentee by the monopoly granted.

It will be observed on reference to the file wrapper and contents of the application (see Record, page 714, folio 1166) that the *original* claim 1, which was erased, was in the following words :

“1. In a brake mechanism the combination of a main
“air pipe, an auxiliary reservoir, a brake cylinder, and a
“triple valve *provided with a device* for admitting air
“directly from the main air pipe to the brake cylinder,
“substantially as set forth.”

The second claims was, and is :

“2. In a brake mechanism the combination of a main
“air pipe, an auxiliary reservoir, a brake cylinder, and a
“triple valve *having a piston whose preliminary traverse*
“*admits air from the auxiliary reservoir to the brake*
“*cylinder, and which by a further traverse* admits air
“directly from the main air pipe to the brake cylinder,
“substantially as set forth.”

The words contained in each of these claims not found in the other are printed in italics for the purpose of ready comparison, and from which it will be seen that they do not differ in substance, when it is considered that the “further traverse” of the

piston is old, and existed in the combination expressed in the 1st claim as much as it does in the 2nd. The two claims are, and doubtless were intended to be, broader than the remaining claims, and the language of the first clearly indicates that it was intended to be broader than the 2nd, because it claims a triple valve provided with means generally, i. e. *a device of any kind* operating to perform the particular function or result stated in the claim, which is the *same* function or result stated in the 2nd claim.

The record shows that this original claim 1, as well as the present disputed claim 2, precisely as the latter now appears in the patent, were rejected by the Patent Office on reference to Boyden's earlier patent No. 280,285, of June 26, 1883.

Following this letter of rejection, the applicant acquiescing therein as to said claim 1, erased the said claim and substituted therefor the present limited and comparatively narrow claim 1 (see file wrapper and contents Rec. pages 717-718) and at the same time erased from the specification the statement quoted, that the "separate valve" could be integral with the "main-valve," and explained that *claim 2* implied the presence of an "auxiliary" valve in "combination" with the triple-valve, in the letter to the Patent Office asking reconsideration and allowance of said claim 2 (see Record, page 718, folio 1175). It is impossible to avoid the effect of this implied disclaimer. In the opinion of the Circuit Court the learned Judge uses the word "so-called" disclaimer, but uses it in reference not to this *erased* clause, but to an *inserted* clause at the end of the specification in reference to the Boyden Patent of 1883. The learned Judge discussed the effect of the Boyden prior 1883 patent, and the *inserted* clause, differentiating it from the invention in suit, but wholly omitted the most important implied disclaimer, arising from the fact that the broadening clause herein first above referred to, and the original first claim founded thereon *were deliberately erased by the patentee after objection and rejection* by the Patent

Office. It is these acts of the patentee which constitute the disclaimer and not the insertion of the clause to which the learned Circuit Judge referred, His opinion construed the 2nd claim in suit as covering, in the words of the erased 1st claim, every "triple-valve *provided with a device* for admitting air directly from the main air pipe to the brake-cylinder," provided it was brought into operation on the "further traverse" of the piston, erroneously assuming that such "further" traverse was *per se* new. Obviously he was wrong, and was correctly reversed.

It is wholly unnecessary for the purpose of the point we are now presenting, to discuss or decide whether or not the Boyden prior patent of 1883 anticipated, qualified or negatived the novelty, in whole or in part, of either of the claims in question. Suffice it to say that the applicant's attorney, at the time of making said amendments, and more particularly at the time of inserting the clause at the end of the specification differentiating said Boyden prior device, *accompanied the same by a letter* in which he refers, not only to the *function*, but to the *structure* of the Boyden patent, and admits in express words *that no claim is made to broadly admit train-pipe air directly to the brake-cylinder*, which, of course, means in a triple-valve device, for that is what the applicant was discussing and what he was distinguishing against. However that may be, he says in said letter, as plainly as the English language can convey the meaning, that his device consists of a *valve auxiliary* to the "triple-valve as previously employed," to perform an additional function, and that its novelty resided in a *combination* of such auxiliary-valve with the old triple-valve. No other meaning can be taken from the applicant's letter, which is as follows (see R., p. 718):

"When, however, the *triple-valve* is *provided* with an "*auxiliary-valve* operated by its piston, which performs "a new function *additional* to that of the *triple-valve* as "*previously employed*, it is believed that such *combination* is wholly novel."

There is nothing in this letter indicating any novelty in the "further traverse" of the piston as a new movement *per se*, because it has no further or other traverse than it had before. The effort was to show that one of the *old* movements of the piston does something which it did not do before **and solely because** of some "additional members" which it actuates on this movement. Every word of this letter indicates that the invention does *not* consist in some improvement *in and of the triple-valve itself*, but of a *combination* of the triple-valve with some *added* or *auxiliary-valve* whereby the *combined* mechanism (not the piston alone, nor the auxiliary-valve alone), may, through the action of the triple-valve piston, produce some new result or perform some new function; and it is "such combination" which the letter says the applicant believes to be wholly novel. And what is said in that letter is not disputed. What is disputed is that the 2d claim shall be construed to be for means which are *not* auxiliary to and not *independent* of the triple-valve as *previously employed*; and for means which are *integral* with the triple-valve to enable it to perform a double function *in and of itself*; which latter is a character of structure which by no stretch of imagination could have been contemplated by the Patent Office officials, as intended to be within any claims of Mr. Westinghouse's patent as allowed to him; and is a construction of the claim involving wholly different principles of mechanical construction and operation; and which could not possibly be evolved from any description contained in the patent in suit.

Claim 2 is in Form and Substance for a "Combination."

We may be pardoned for referring again to the file and contents of the application for corroborative support of the following view of the claim in question. The letter of the patentee, Record, p. 718 (written after rejection and erasure of original claim 1 and present claim 2, and asking reconsideration and allowance of present claim 2, notwithstanding its previous

rejection), clearly shows (as does also the language of the claim itself), that the invention patented is a true *combination*, in the technical sense of that word, with a "triple-valve," of the "additional members" described in the specification, or their mechanical equivalents, which are to be "auxiliary" to the "triple-valve" and "independent of the main-valve" thereof.

The theory advanced by Westinghouse counsel that the idea of a "combination" may be brushed aside, is not sound, because not only is the claim in form for a combination, reciting the several elements thereof, but the claim uses the word "combination;" and the explanatory letter referred to says, "when, however, the '*triple-valve*' is provided with an '*auxiliary-valve*,' etc., it is believed that such *combination* is wholly novel." Is not the invention covered by this very claim (which is the one in dispute), therefore, by the force of these words, a true "combination" in the technical sense? How, therefore, can the new elements—the "additional members"—be wholly dropped out, and the "triple-valve" element (which the specification says is the well-known triple-valve of 220,556 with its graduating-valve and main-valve), be reconstructed to make its *same identical valves* do something which as valves of a "triple-valve" they could not possibly do, and hence make it a wholly different thing from the "triple-valve" expressly made a separate and distinct *element* of the *combination* patented? Moreover, such a substitution of a different "triple-valve" element breaks up the "combination" referred to in the applicant's letter, because it not only discards entirely the "additional members" referred to in the specification, or any mechanical equivalent thereof, or any substitute therefor, but it requires, in order to produce the result sought for, a remodeling of the valve-chamber of the "triple-valve" element in order that while retaining all its (old and usual) triple-valve functions, it shall be enabled thereby to produce the additional result sought for; and this reconstruction of *that element* the Patent Office has correctly ruled is the invention of Mr. Boyden.

Several Views Under which the Machines may be Compared.

1. It seems impossible to conceive of two machines so alike in results, and yet more widely and radically different in principle of construction and operation. No man could construct the defendant's device nor obtain the slightest aid in so doing, from anything contained in the plaintiff's patent, not even the patentee and co-plaintiff, Mr. Westinghouse, whom, it is not inappropriate to add, has not testified in this case nor attempted to assert to the contrary. This is a significant circumstance, and entitled to be considered, more especially if our contention be well founded in law, that the offer of defendant's patents in evidence rebutted the plaintiff's *prima facie* case and shifted the burden of proof.

2. Another principle—or rather maxim—of the patent law, is applicable here to aid us in determining this issue of fact viz.: the rule that what will infringe if later will defeat if earlier.

Let us, therefore, suppose that the triple-valve device of the defendant (which has no by-passage and no "auxiliary-valve," but in which train-pipe air is admitted to the brake-cylinder by a remodeling of the old "triple-valve" element), *preceded* Mr. Westinghouse's invention of the patent in suit, the latter would be the very first to state, that his invention was not anticipated thereby, because (he would argue), that taking his old "triple-valve" of 220,556 and *without remodeling it in any respect*, he made a new "combination" (in the strictest technical sense), with such "triple-valve" (and without thereby changing or adding to or subtracting from any of its parts or of the functions of any of its valves or chambers), of certain "additional members," in every sense (both physically and functionally), so *auxiliary* to the "triple-valve element of the combination that it must not be "integral" with the main-valve thereof (see statement erased from specification), and must be "independent" thereof. He could, therefore, truly and correctly contend

(if Boyden's device in suit preceded him), that the latter did not anticipate the "combination" of elements which he has thus shown and described in his specification, and pointed out in his claims—by *express words* in all the claims but the 2d, and by clear implication in the 2d claim, as was obvious to Judge Lacombe as stated in his opinion in 65 Fed. Rep. 99.

3. It seems almost a work of supererogation to cite other proof of differentiation, but let us, out of caution, do so. It has been seen that the plaintiff's device as shown and described has in combination a triple-valve, and added thereto a separate and segregated passage-way leading directly from train-pipe to brake-cylinder and a valve controlling it which is auxiliary to the triple-valve entirely outside of it, and *physically disconnected from it*; while the defendant's device has no additional passage-way at all, leading either directly or indirectly from train-pipe to brake-cylinder, and of course has no auxiliary or other valve to control a port or passage which has no existence, but consists, not of a "combination" with an old "triple-valve" element of some auxiliary device, but of the old "triple-valve" element remodelled by simply partitioning its piston chambers, whereby the old valve-chamber became a passageway not only for reservoir-air as it always was and still is, but for train-pipe air as well, and the main valve of the triple-valve not only admitted reservoir-air (as it always did and still does), but admitted train-pipe air as well on a full stroke of the piston. But this full or further stroke is the same action and for the same purpose as and for which it always was performed, *i. e.*, actuating the main-valve for admitting maximum reservoir pressure for emergency purposes. The mere fact that in plaintiffs' device another and auxiliary-valve is so placed *outside* the triple-valve chamber that on a full stroke of the piston it will strike such added valve, does not make such *old further traverse* a new function of the piston. The *combination* with such piston, having such a stroke, of an added element—a new valve—gives the *entirely* a

new function, but it is unsound and fallacious to say that the *further traverse* is per se a new function of the *piston*.

(4.) In view of what has been said, let us look at the collateral circumstances in respect of the *by-passage* controlled by this new *added* valve, the two constituting the "additional members" described in the specification. How can the plaintiff reasonably contend that the word "directly" in the claim does not imply a segregated passageway, and that "auxiliary" does not mean "additional" in respect of a valve which the description says is to be "independent" of the valves of the (old) "triple-valve" element in the "combination" pointed out in the claim? The surrounding facts preclude the possibility of any such contention being sound, and of these it suffices to mention the following only.

(A.) The disclosure is shown in Boyden's earlier patent of 1883 (four years in advance of Westinghouse's patent in suit), of a "triple-valve" of the slide-valve form, with a check-valve opening in its piston (exactly the same in that respect as defendant's present alleged infringing device), which operated *to admit train-pipe air through the triple-valve chamber* (such air being admitted, however, to augment the brake-cylinder pressure), thus showing *how* train-pipe air could be admitted to the brake-cylinder *through the triple-valve chamber* without any separate or additional passageway. THIS WAS FOUR YEARS BEFORE THE DATE OF THE PATENT IN SUIT. (See Record, page 498, and cut opposite).

(B.) To that earlier device, Mr. Boyden added in 1888 the further invention of producing *differential pressures* in the "triple-valve" chamber by means of a *partition* therein with a restricted opening, and so operated the old valves (not new or additional ones), of the "triple-valve" to admit train-pipe air in advance of or simultaneous with reservoir-air, and thus produced "quick action," so-called.

(5.) Before concluding the presentation of our views on this particular aspect of the cause, we desire to call the attention of the Court to, and to thank our learned opponents for, the very frank and truthful admission contained on page 7 of the Westinghouse Supplemental Brief, as follows:

"The two valves of defendant's structure are *both* capable of *admitting auxiliary reservoir air only*, **"when the partition 9 is absent**, because in the structure as thus organized, *there are no such air-passages* as to make it possible for **any movement** of the triple-valve piston to result in opening **any port** by which *train-pipe air* could be admitted to the brake-cylinder."

The following conclusions logically follow from this absolutely true fact, so admitted:

(a.) The defendant's structure (without the partition 9) has two valves—a graduating-valve and a main-valve—and a piston with two movements—a preliminary and a further—the first movement actuating the graduating-valve and the further movement actuating the main-valve; and this structure, *so organized* (without the partition 9) will admit only reservoir air to the brake-cylinder, *no matter whether the piston makes a preliminary or a full traverse*; and the defendant's device so constituted (without the partition 9) will neither produce the new result of the plaintiff's device (admitting train-pipe air,) nor in any manner interfere with the plaintiff's claim, taken in its broadest and literal sense; and finally, that this defendant's device (without the partition) is an operative "triple-valve" for admitting *reservoir air* (only) by means of two valves actuated by the two movements of the piston, respectively.

(b.) That the identity of *said device*, WHEN THE PARTITION IS PLACED IN THE VALVE-CHAMBER, with the Westinghouse invention in suit, is, therefore, dependent solely upon whether or not Mr. Boyden's reorganization of the *valve-chamber* of the "triple-valve" element, AND WITH NO OTHER CHANGE WHATSOEVER, is the *mechanical* equivalent of Mr. Westinghouse's

"combination" with a "triple-valve" (as an entirety and unaltered), of two other distinct elements (a separate passage-way 46 and an auxiliary-valve 41 to control it), the latter being in no sense any part of the "triple" nor affecting its action or function as *such*, but on the contrary being "additional members," distinct elements or integers, in a true "combination" of elements, some old and some new—to produce some *new* result?

(c.) This is exactly the proposition into which Judge Hughes crystallized the whole case when he said, in his opinion (R., p. 880).

"As there was no novelty in the extreme traverse of the old triple-valve piston, it must be eliminated from consideration and the mechanical equivalency of Boyden's device of the partitioning ring integral with the triple-valve itself, on the one hand, and on the other hand, the Westinghouse device attached to the triple-valve, and consisting wholly of apparatus not integral, but segregate, individual, several, *additional to and independent of it*, depends upon the character of the two devices themselves, considered and *compared apart from* the extreme traverse, and not upon their being put in action by the extreme traverse *of the triple-valve piston*."

And this proposition he repeats in a paraphrased sentence on previous page (878), premising it by the statement that it is "the question at bar" thereby expressly saying that it is *the* question, the decision of which ruled the decision of the case and constituted the matter adjudicated.

His answer to his own question thus tersely put, twice in the opinion was "that they seem to us to differ as widely from each other as two devices for accomplishing the same result can well differ." (R., p. 880, folio 1419.)

He was undoubtedly correct. And his conclusion is corroborated by the paragraph we quote above from page 7 of plaintiffs' supplemental brief.

Comparison of the Devices by Comparison of the Functions of Their Pistons.

The error underlying the Westinghouse argument to show "substantial identity" is that while they admit that the "further traverse" of the piston is *per se* old, they argue that it performs a new function when it actuates *any* valve and opens *any* passage to produce the *new result* of admitting train-pipe air.

Their contention in this regard is untenable, (1) because so broad a construction amounts to a reinstatement of the rejected and erased original claim 1 for the "combination" with a "triple-valve" (having *two movements* of its piston) of "*a device*" for admitting, &c.; and (2) because while it is true of the Westinghouse machine that its "further traverse" of piston does something which it did not do before, *it only does it because* of the true "combination" therewith of an *added* valve and an *added* passageway. But it is not true of the Boyden machine, because it is PHYSICALLY IMPOSSIBLE for HIS piston to do something which it did not do before, for his piston has the same two movements it had before, *it controls the same two valves it did before and in the same way*, and it is not combined with nor does it actuate any new or added valve, nor control any new or added air-passage, and, in fact, does nothing more nor less than it did before, but simply actuates the old valves which governs the same old "triple-valve" passages that they always controlled and exactly in the same way.

Obviously it is the *partition* in the valve-chamber (producing differential pressures), and not the partition plus the *piston*, that produces the new function or result in Boyden's machine. It is not even true that these differential pressures are produced only on a movement of the main-valve 22, which occurs on the further or full traverse of the piston; but if it were so, it still would not sustain the plaintiff's proposition (as respects the

Boyden machine), that this further movement of the piston is the primary cause or in any manner aids in the production of the new result, because this further movement of the piston does not co-act with the partition, it co-acts with the *(old) valves* and only *in the same way and exactly for the same purpose as before*. Take the partition out of the device and the fact is demonstrated to an absolute certainty.

The plaintiffs have confounded the principle of their own machine with ours in respect of the alleged new function performed by the piston, because, in respect of theirs, their contention is quite true—for in theirs the piston on its further traverse does something which it did not do before—it contacts with and moves a *new* valve, and which thereby opens a *new* air-passage; but it is a mistake to say, even in respect of *their* machine, that it is the further traverse alone which produces the new result of admitting train-pipe air, because obviously it is the result solely of the “*combination*” with such “further traverse” of an *added valve* and an *added* air-passage, *all of which co-act*, and *must* co-act to do this new thing.

On the other hand, in the Boyden machine the *piston* does not co-act with any new valves, *for there are none*; and it does not, either directly or indirectly, open any new passageway, *for there is none*; and surely it does not co-act with the partition, nor does it co-act in any new way with the *main-valve 22*, to produce this *new result*, in that it moves *that* valve only on its further traverse, for the very obvious reason that it opens *that* valve now, exactly as it opened it before (in prior triple valves) to wit, on its “further traverse,” and *only* on its further traverse.

Some notice ought to be taken of the assertion in Westinghouse supplemental brief, pp. 6 and 7, that the Boyden device, if stripped of its partition, is a “structure which no one uses or wants to use.” We might truly say the same thing of plaintiff's automatic device of their patent 220,556, if we add—when they (the public and users) can get either of the improved devices of either of the patents in conflict in this case. It is to be

observed, also, that the plaintiffs do not attempt to deny, (1) that the device (without the partition) is a perfectly practical and useful automatic triple-valve; (2) that it has two valves and two movements of its piston, operating said valves in the manner already stated; (3) that it is free to be used by anyone since patent 220,556 expired; (4) that it contains the principle of delivering reservoir-air by means of a graduating-valve and a main-valve, the former doing ALL the *graduating work* and the latter doing none of it, and acting only for "full and emergency application" work, and then only on a further or final traverse of the piston. This is the principle and mode of operation of the expired patent 220,556, and we challenge our learned opponents to deny it or qualify it; and we further assert that Boyden's device (when stripped of its partition) becomes a practical and useful and complete embodiment of the device of the expired patent 220,556; and which assertion it would not be left to us to make, if that patent was still in force.

But, suppose this was not so, this court will be unable to find anywhere in any of the briefs of our opponents a denial of our proposition, (which alone is the material subject) that the Boyden machine (if stripped of its partition) is equally with the machine of 220,556 a practical, useful and complete device to admit reservoir-air to the brake-cylinder, both for graduation or service, and also for emergency work.

The argument made in Westinghouse's supplemental brief that the "triple-valve" which Boyden improved by partitioning its valve-chamber, is a device unknown in the prior art because it has two valves and not one valve, is erroneous for two reasons: *First*, because patent 220,556 is expressly for a graduating-valve additional to the *main-valve*, both valves for *reservoir-air* admission, and *that patent is not confined to the slide-valve form*, but would include the poppet-valve form, as Westinghouse would quickly assert if the patent was still in force, and hence would include a "triple-valve" (without Boyden's partition) but

with his graduating-valve i, j, k and main-valve 22, as now used by him. *Second*, because, as correctly stated by Judge Morris (R., p. 846, folio 1367), that

“The use by Boyden of a central opening through the
“triple-valve piston to admit train-pipe air to the triple-
“valve chamber was not new, nor the use of a poppet-
“valve for the main-valve of the triple, both of these
“constructions having been shown in the Westinghouse
“patent 141,685 of May 24, 1873.”

Note.—Such a method of feeding-in train-pipe air *to charge the reservoir* was old, as the Judge says; and he might very well have added that such a central check-valved opening in the piston to admit train-pipe-air *to the brake-cylinder to augment the pressure, was old and was the invention of Boyden* and was described in his 1883 patent—the very patent on which this disputed claim 2 of Westinghouse’s patent in suit, was originally rejected, and against which Westinghouse distinguished in his letter by claiming that his (Westinghouse) device was a “combination” with a “triple-valve” of an “auxiliary-valve” &c.

The attention of the Patent Office was also called to this, by a paragraph in Boyden’s 1892 patent, No. 484,134, as follows (see R., p. 797):

“In my present invention I use the check-valved feed-
“passage of my 1883 patent, leading from the train-pipe
“through the triple-valve piston to the main-valve cham-
“ber, and thence both to the auxiliary-reservoir and the
“brake-cylinder, for the double purpose of supplying the
“auxiliary-reservoir and also enabling train-pipe air to be
“vented directly through the main-valve chamber into
“the brake-cylinder to aid in supplying the brakes in
“emergency stops.”

Comparison of the Facts in the Case at Bar with the Facts Involved in Burr vs. Duryee and Gill vs. Wells.

(See illustrations on folder, opposite p. 53 of this brief).

The opinion of Mr. Justice Clifford in *Gill vs. Wells*, 22 Wallace 1, suggests three several tests we may apply to the facts in the case at bar to determine the correctness of our general conclusions:

I. It was said by Judge Clifford that the dropping out in the reissue claim, of the tunnel or trunk for directing the fur to the cone, and substituting "means for directing the fur to the cone" made the reissue void as for a *different* invention. *Sem-ble*, it would have been held none the less a *different* invention if its identity had been the subject of inquiry as an alleged infringing device in a suit charging infringement of the original patent.

II. Let us now suppose that Westinghouse had amended and reissued his patent in suit (as Wells did), by eliminating the description of the segregated passageway leading *directly* to the brake-cylinder, and by dropping out the auxiliary or additional-valve and substituting therefor a description of and claim for a device (such as Boyden's), in which the "triple-valve" chamber was used as the so-called *direct* passage, and the *main-valve* of the triple employed not only to do its own work as before, but endowed with a new and *additional* function by a *remodelling of the valve-chamber of the "triple-valve" element* of the "combination" of the original patent, and by means not even remotely suggested in the specification and *solely whereby* one of the old valves performed a new function. Can it be doubted for an instant that this Court would say without the least hesitation, that such a reissue was for a *different* invention? It is none the less different because it is the subject of a subsequent original patent to a different person.

In *Gill vs. Wells*, 22 Wallace 1, the learned Judge considers the question of identity under the doctrine of equivalents, and states it thus :

“Whether one device is or is not an equivalent for another is usually a question of fact * * and the rule is that if the defendant omits entirely one of the elements of the patented combination, without substituting any other, he does not infringe, and if he substitutes another in the place of the one omitted, which is new or which performs a substantially different function, or if it was not known at the date of the plaintiff's patent as a proper substitute for the omitted element, he does not infringe.”

These remarks are pertinent to the case at bar, in which the “additional members” constituting the only novelty in the patented combination, are omitted entirely, and nothing substituted for them to perform their function, it being performed by mechanism operating on a different principle and not known at the date of the plaintiff's patent but invented afterwards.

III. Another view of the case at bar may also be taken. Beyond doubt a patent is a contract and the consideration for the monopoly is the description in the specification, not alone of the specific mechanism shown in the drawings, but a full, clear and exact description of its mode of operation, i. e., its principle of construction and operation, in order that the public may be able, after the expiration of the monopoly, to make, and use the invention in all the possible forms or modifications, embodying the principle or mode of operation disclosed, that would be suggested to a mechanic skilled in the art. Looking at this Westinghouse specification of the patent in suit, in that light, can any one fairly say that it teaches that the “triple-valve” element of the “combination” need not be the triple-valve in any of its various forms referred to in the specification, but may be a triple-valve provided with modifications (not described and not then known) to produce differential pressures therein and

thereby give different and additional functions to *its* valves, and that by so doing, the directions of the patent to provide an "auxiliary" valve "independent" of the triple, and a separate passageway leading "directly" to the brake-cylinder, *may be disregarded?* We fail to find anything in the specification which teaches this, and not a single person interested in the case, either party, witness or counsel, has been bold enough to assert that it does. Yet it is necessary that it should in order to find identity of the defendant's device with the machine of the patent in suit.

In *Burr vs. Cowperthwait*, 4 Blatchford 163, which was a suit on the Wells patent for a machine for making hat bodies, the Court (Ingersoll, J.), stated the rule of *O'Reilly vs. Morse*, (15 Howard 62, 119), as to functional claims, and applied it to the case there under consideration in language which may aptly be applied to the case at bar.

In that case the means or mechanism used by the defendant produced precisely the same *result* as the patented mechanism, and the functions of certain old parts of the two devices respectively were identical; but in the plaintiff's patent it was pointed out that it contained a channel or way interposed between the picker-cylinders and the revolving cone, combined with means to guide or direct the sheet of fur on to the revolving cone, which said guiding or directing elements (which distinguished the novelty of the machine), were found to be wholly unnecessary in the defendant's machine and not contained therein, although said machine produced the same results as the plaintiff's of directing the fur to the revolving cone, and the same variable thickness of fur by controlling the manner of feeding the fur. The Court held that there was no infringement. The same construction was afterwards given to a subsequent re-issue of this patent, in *Burr vs. Duryee*, 1 Wall. 531, and again on a further re-issue of the patent, in case of *Gill vs. Wells*, 22 Wallace 1.

After the decision on the Wells patent, in *Burr vs. Cowperthwait*, the patent was re-issued to cover, in the combination with the rotating exhausted cone, *means* for directing the fur therto, instead of the specific means formerly claimed and described in the specification. As thus re-issued, the patent was passed upon by this court in *Burr vs. Duryea* 1 Wallace 521, in which Justice Grier, delivering the opinion of the court stated several principles, aptly pertinent under a similar state of facts in the case at bar, as follows :

“An infringement involves substantial identity, whether that identity be described by the terms ‘same principle’ same ‘modus operandi’ or any other * * *.”
 “The argument used to show infringement assumes that every combination of devices in a machine which is used to produce the same effect, is necessarily an equivalent for any other combination used for the same purpose.”
 “This is a flagrant abuse of the term ‘equivalent’ * * *.”
 “To constitute an infringement it must be a copy of the thing described in the patent, either without variation, or with such variations as are consistent with its being in substance the same thing.”

In that case it appeared that the defects in prior machines resided in their want of means to *guide and direct* the fur to the revolving cone and deliver it thereon in variable thicknesses at different points. *It was conceded that Wells, the patentee, was the first to produce that result in such a machine ;* and great stress was laid upon that fact in the effort to induce this court to give a broad range of equivalents for the *expressed* novel element (in *Burr vs. Cowperthwait*) and to the re-issued 1st claim, (in *Burr vs. Duryea*), for the indefinitely stated “means for directing the fur-bearing current,” as the novel element in the combination made the subject of the re-issue claim.

In both cases, however, the courts refused to give undue effect to the so-called pioneership of the invention, as to make it cover “means generally ” for directing the fur. It would

not have helped the patentee to have added "when operated or brought into operation by the driving mechanism," if such driving mechanism was old in such machines. No more can similar words, "actuated by the piston on its further traverse," help the plaintiff here to claim "means generally" for admitting train-pipe air "directly to the brake-cylinder." Such introduction of actuating devices into an otherwise indefinite claim do not help it out, when such actuating means are shown to be old and acting as such as they always heretofore acted in like machines, which differ from the patented machine only in not containing as an "additional" element, the "means" for producing the new or added function, in the new "combination" made up by adding to the *old* machine such new "means." In that case, the machine of the defendant, Duryea, was a machine patented to one Boyden, in whose patents statements were contained (exactly as in the Boyden patent in the present case at bar), that the object was to produce the same result as the Wells machine, but by discarding the Wells principle and mechanism, the words of *that* Boyden patent being quoted therefrom in the report, as follows, (1 Wallace, p. 562-563):

"This invention relates to an improved mode of directing or guiding the fur, as hereinafter fully shown and described, *whereby trunks and all other comparatively complicated appliances hitherto used for the purpose are dispensed with*, and an exceedingly simple and efficient device substituted therefor.

"The invention consists in placing directly in front of the picker a plate so bent or curved that its surface will have a certain relative position with the axis of the picker and the surface of the cone, and give such a direction to the fur as the latter is thrown on it by the rapid motion of the picker that the fur will be drawn properly on the cone by the exhaust or suction within it."

Later on in the opinion, this Court explained away the so-called "substantial identity" of the two machines, in its own language, differentiating it from Wells, as follows (see page 572 of 1 Wallace):—

"Now the machine of Boyden has not one of the peculiar devices or combination of devices of the Wells machine, nor any substantial identity with it, unless by substantial identity is meant every machine which produces the same effect. These abstract phrases 'substantial identity', 'equivalent', 'mode of operation', &c. are often used in such a vague and equivocal manner that they mystify and lead many to absurd conclusions, who will not distinguish between things that differ. That two machines produce the same effect will not justify the assertion that they are substantially the same, or that the devices used by one are, therefore, mere equivalents for those of the other. There is nothing in the Wells machine, or its devices, which suggests the peculiar device employed by Boyden. His machine has no tunnel, no cap, no flap, nor any equivalent thereof, nor does it incorporate in its structure the substance of the first invention. There is nothing to be found in the specification of Wells which would ever suggest the peculiar device of the Boyden machine. As an improvement it has more claims to originality than that of Wells."

Later on in the opinion, the Court comparing the specifications of the plaintiffs' and defendants' patents, said (see page 573 of report):—

"No one who reads the two specifications, or inspects the two machines, can aver that they contain the same combination of mechanical devices, or substantially the same, to produce the desired affect. Not one of the devices, or its equivalent, used in one is to be found in the other, nor is its mode of operation the same. The argument used to show infringement assumes that every combination of devices in a machine which is used to produce the same effect is necessarily the equivalent for any other combination used for the same purpose."

It must be remembered that this finding was, notwithstanding the fact, as stated by Judge Ingersoll, and so argued in this court (page 551 of report), that "before the discovery of Wells, no machine was known or used that did, by *any means*, direct a sheet of fur on to a section of a revolving cone, * * to form a bat of fur on the cone, * * of the desired shape and thickness, * * at the will of the operator." And it may also be broadly and properly observed that the re-issue claim was for "means for directing the fur-bearing current."

This case has never been overruled, but, on the contrary, was followed, in a subsequent second re-issue of the same patent, in *Gill vs. Wells*, 22 Wallace, 1; and the same interpretation of the *actual invention* adhered to, notwithstanding the general, broad and indefinite language of the re-issue claim.

Strong efforts were made in *Burr vs. Duryee*, to urge upon this Court the so-called pioneership of the Wells machine, but this Court said, defining pioneership :

"We are of the opinion that the invention of Wells was * * not founded on any new discovery of the application of any element or power of nature to produce an effect. He was not the first to devise the application of a vacuum to a cone for the purpose of forming and compressing bats for hat bodies. * * He has improved this machinery by his peculiar devices * * combined in a machine which however failed to be automatic till further improved. * * As required by statute, he truly and correctly stated the principle or mode of operation of his machine and the functions performed by its several devices. * * He has a valid patent covering his whole invention—no more, no less."

These remarks in *Burr vs. Duryee* were made in respect of facts exactly parallel to those in the case at bar. It cannot be pretended that the Westinghouse patent in suit is a pioneer within the true definition above described; it cannot be pretended that it discloses for the first time the principle or idea of quickening the serial action of the brakes by venting the train-pipe

at intervals at or near each of them (R., p. 68, l. 7, and R., p. 759, l. 42); it is not pretended that the earlier Boyden patent (R., p. 498, l. 3) of 1883 (4 years ahead of Westinghouse) did not admit train-pipe air as well as reservoir-air to the brake-cylinder, and it is expressly admitted in the applicant's letter to the Patent Office, that it is not intended by his claim 2 to cover broadly the admission of train-pipe air to the brake-cylinder (R., p. 718, l. 37)—and of course he meant in a "triple-valve" device, for that is what he was distinguishing against, for he was endeavoring to show that Boyden's prior patent of 1883, for a triple-valve device in which train-pipe air was admitted to the brake-cylinder was not a quick-action device.

In the case at bar the plaintiff has strongly urged this Court to overlook differences in mechanism of the respective devices and obvious differences in their principle of construction and operation respectively, on the plea, whether true or not, that Westinghouse was the first to put into practical form a triple-valve device having additional members which performed the additional function of admitting train-pipe air to the brake-cylinder to quicken the action of the brakes. In other words, having, as he alleges, whether true or not, been the first to produce this result, he asks the Court to construe his patent so broadly as to cover every device to accomplish that purpose which is made a part of an old triple-valve, and operates in conjunction therewith. To sustain such a contention at this late day, would be to overthrow a long line of decisions to the contrary. Precisely the same claim and the same contention was made in *Burr vs. Cowperthwaite*, supra, in which the Court admitted that:

"It is clear that before the discovery of Wells' no machine was known or used that did by any means direct a sheet of fur on to a section of a revolving, exhausted, perforated cone or other form, parallel with the axis so as to form a bat of fur on the cone or other form, of the desired shape and thickness in properly regulated quantities at the will of the operator." * *

In that case the bill was dismissed, because the Court did not find in the defendant's machine the mechanism described in the patent, or the mechanical equivalent therefor to control or give direction to the sheet of fur carried by the current of air to the cone. Nor was there anything substituted therefor, it having been found in the defendant's machine (which was the same machine as in Burr vs. Duryee and Gill vs. Wells), that the current of air, which carried and directed the sheet of fur, was controlled by the picker-cylinders, *without the aid of the plaintiff's guiding or directing devices, or of any substitute therefor, or of any device, in fact, interposed between the picker cylinders and the rotating cone.* The Court said in its opinion that it was a complete and useful machine without any such mechanism or any guiding device being interposed between the parts named for guiding and directing the fur to the cone. The language of the opinion being as follows, (4 Blatch, 171):

"It is a complete and useful machine for forming bats
 "of fur on a perforated exhausted cone, without any
 "trunk or channel-way, or other device interposed
 "between the picker-cylinders, rotary brush or other dis-
 "integrating apparatus and the cone on which the bat is
 "to be formed. * * * Without such trunk, channel-
 "way or other device so interposed, the defendant's
 "machine is a perfect one complete in all its parts.
 "*Without it the plaintiff's machine would be use-
 "less.* In one machine the trunk, channelway or other
 "means so interposed is an *essential* means. In the other,
 "it is a *non-essential*. In one machine the trunk with
 "hinged hood controls the current of impelled fur in the
 "direction it should go. In the other other, the current
 "of impelled fur is directed and controlled in the way it
 "should go, by the power of the picking cylinders."

This case in its facts is exactly parallel with that at bar. The Westinghouse patent points out distinctly that it is *essential* to have a segregated or additional passage used to *direct* the train-pipe air to the brake-cylinder, and equally essential to

have an *auxiliary*-valve to control that segregated passageway, and also that the auxiliary-valve is no part whatever, either physically or functionally, of the triple-valve element in the combination, the same being "independent" of the main-valve thereof. In the defendant's, neither the by-passage, nor the auxiliary-valve to control it, are essential nor even useful, nor are they, or any substitute for them, present.

Exactly as in the hat body case, so the defendant here has found, that by using his system of *partitioning the valve chamber* of the triple-valve he can direct the train-pipe air, when required, *through the triple-valve chamber* and control it by the *valves of the old triple-valve*, and that he does not need the additional passageway and auxiliary-valve of the plaintiff's invention nor any equivalent therefor, or any substitute therefor, and, in fact, dispenses with them altogether. It would be difficult to find two cases more closely parallel in the essential facts controlling their decision. (See illustration and comparisons on folder.)

Comparison of the Findings of Fact in the Case at Bar, with Like Findings in Burr vs. Cowperthwait.

Ingersoll, J. in *Burr vs. Cowperthwait*, 4 Blatch (170):

"In defendant machine, there is no guiding trunk, "interposed between the pickers and the cone, to control "and give direction to the sheet of fur carried by the "current of air on to the cone. Neither is there anything "either as an equivalent to the guiding trunk, or in lieu "or in substitution thereof, or for any purpose, interposed "between the pickers and the cone."

Morris, J. in *Westinghouse vs. Boyden Brake Co.* (R., p. 838, folio 1365.)

"I am not satisfied * * * that the poppet valve "22, of the Boyden mechanism is such a (an auxiliary) "valve, for Boyden's poppet-valve 22 does * * * to

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"some extent perform the functions of a main-valve of
 "the triple, as well as the function of Westinghouse's
 "auxiliary quick-action or emergency-valve. * * *
 "Valve 22 will, if the engineer uses his break carefully,
 "do the work of a main-valve, as is *demonstrated*, I think,
 "by the experiments in which the sensitive graduating-
 "valve *ijk* was plugged up. So I take it that defend-
 "ant's valve *ijk* (40) must be held to be the sensitive grad-
 "uating-valve usual in triple-valve devices, since Patent
 "220,556, and the defendant's valve 22 must be held to be
 "the *main-valve*, and that in defendant's mechanism he
 "has been able, by an ingenious arrangement restricting
 "the admission of auxiliary-reservoir air to the triple-
 "valve chamber, to cause the *main-valve* to do both main-
 "valve work when needed, and to do quick-action work,
 "when needed."

If this be true, then the plaintiffs' proposition (on pages 47
 and 48 and repeated several times thereafter on pages 67, 73 and
 78 of their *principal* brief), that "the real 'main valve' of Boy-
 den is the valve *i, j, k*, (40), through which auxiliary-reservoir air
 is admitted for all practical purposes * * * and that stem-
 slide valve (*i, j, k*) is the true 'main valve' *cannot be true*."

The crucial test question was correctly put in the case at bar
 by Judge Hughes of the Court of Appeals (and correctly answered
 in the negative by him) as follows; premising his remarks by
 the statement, that:

"The transmission of train-pipe-air and auxiliary-reser-
 "voir-air simultaneously to the brake-cylinder is a result
 "or function and is not patentable." (Precisely as this
 "Court said of the hat body machine, in *Burr vs. Duryee*
 "and *Gill vs. Wells*, that the '*directing of the fur* from
 "picker to cone' was not the 'mode of operation of the
 "machine,' but the *result* of the use thereof). The mean-
 "(Judge Hughes says) by which this or any result or func-
 "tion is accomplished may be many and various and if
 "these several means are not *mechanical equivalents*,
 "each of them is patentable,' adding: 'The question at

"bar' is whether defendant Boyden's machine in which "the same result is attained (by a novel reconstruction of *the 'triple-valve' itself*), is the *mechanical equivalent* "of Westinghouse's 'attached machine,' non-integral, "segregate and individual consisting of another stem, "another valve, and by-passages peculiar to itself, leading "from the additional valve to the brake-cylinder."

After stating that this precise question was necessarily passed upon by the Patent Office in the grant to defendant of broad claims in his patent therefor, the learned Judge for the fourth circuit added that while such ruling was evidence of great weight though not conclusive, he fully concurred therein, and said:

R., p. 880. "Comparing the two devices apart from the "triple-valve piston in extreme traverse, we are unable to "entertain a doubt that the ruling of the Patent Office "was correct to the effect that Boyden's device was not "the mechanical equivalent of that of Westinghouse. "They seem to us to differ as widely as two devices for "accomplishing the same object can well differ."

"The plaintiff's contention is that Boyden's main-valve 22 is the equivalent of the Westinghouse "auxiliary-valve because, 'Boyden makes it perform the "same purpose.' But Boyden's 'poppet-valve' 22 (substituted) for the slide-valve (which) is the main-valve of "220,556. Boyden's is not an 'auxiliary-valve;' it is "mechanically the original main-valve of the original "triple-valve, and it performs the service which is performed by the main-valve of 220,556. It is not the "mechanical equivalent of (auxiliary) valve 41' (simply "because it performs an additional duty). 'The performance *incidentally* of quick-action service does not make "it an 'auxiliary-valve.' *It is the same valve.* The incidental service is auxiliary, but the valve itself is the "same and unchanged." (R., p. 881).

R., p. 882 "Obviously there is no 'auxiliary-valve,' "independent of the main-valve, in the Boyden device."

Summary of Conclusions.

The defendants do not infringe this patent upon any construction of claim 2, which would not require it to be defeated for want of novelty in its expressed combination of mechanism, or as claiming a mere function or result. In view of the prior art shown in the patent 220,556 and frankly admitted in the patent in suit, Westinghouse invented nothing but the segregated "additional members" making a new "combination" with an old "triple-valve."

Westinghouse proceeded upon the principle of *adding* a separate machine, without disturbing the "triple-valve" element functionally or physically. Boyden abandoned all idea of a separate machine, or a separate valve, or a separate air-passage, and commenced with the idea of using the *same* valves (retaining all their old functions), and the same passage through the triple-valve chamber (it retaining its old function of venting reservoir-air), relying solely upon his new idea and means of effecting differential pressures in the valve-chamber to effect the entrance of train-pipe air when his *main-valve* is opened by a full traverse of the piston to vent reservoir air (as before), for emergency or full-brake pressure work.

The plaintiff's contention may be fairly stated from their brief as follows:—Claim 2, they say, includes by implication (1) an "auxiliary" valve "independent of the main valve"; (2) a passageway capable of conducting train-pipe air to the brake-cylinder, without passing through the reservoir, and (3) a triple-valve, having at least one valve to control the reservoir port, and also a piston whose short traverse actuates the reservoir-air valve and whose full-traverse actuates the train-pipe-air valve.

In order to find infringement by defendants, they assert that the specification of the patent discloses sufficient to justify

calling the following remarkable changes "mechanical equivalents" of the three elements named; viz.:—

I. The "further-traverse" of the piston, while *per se* old and still retained for its primary purpose of actuating the main-valve, *performs a new function*, they say, because it moves an "auxiliary" valve which has been so located in the structure as to be actuated when such usual and old further-traverse occurs; although it is obvious from the mere statement of the proposition, that the new function, in so far as it involves any novelty or patentability (quoad the prior patent 220,556, which had the same movements of piston), is produced by the "combination" of piston **and valve**, and not by the piston alone.

II. That the "passageway" for admitting air "directly" from train-pipe to brake-cylinder, they say, need not be a *separate* passageway, but may be the valve-chamber of the "triple-valve", through which reservoir-air is admitted; although such chamber is old and still performs its old function and is retained for *that purpose*, and so it is said that the triple-valve chamber also performs a new function, to wit, the function of the separate passageway of the patent, which latter may be, under such circumstances, entirely dispensed with.

III. While it is true, they admit, that the auxiliary-valve must be "independent of the main-valve" of the triple, and although it is true that "triple-valves" having both graduating and main valves, of both slide and poppet forms, were well known in the art, and operated by the piston by its preliminary and final movements respectively; yet they say no man may give *one of those old valves* in such *old* structure an additional function—though he do so by means of his own invention of mechanism of a character not even remotely hinted at in the patent in suit.

IV. The "auxiliary" valve, they say, may be on the reservoir side of the piston and therefore enclosed within and a *part of* the "*triple-valve element* of the "combination"; although it is

obvious that such reconstruction of that element would drop out both the "additional members" described *as essential* in the patent in suit.

V. Notwithstanding that the machine would *not* produce quick action with all four of these changes, nor *unless differential pressures were produced by special means, operating at the proper time, in the valve-chamber*, yet differential pressures (they say in their brief but not in the record), and equivalent means to produce them, exist in the Westinghouse device; notwithstanding that the patent does not contain the most remote intimation of such a thing, and not a word of evidence in the record tending in the slightest degree to dispute with Mr. Boyden the pioneership in *valve-chamber* differential pressures and his means to produce them, and notwithstanding the *prima facies* arising from the grant to him of his patent for *such* means, so operating.

This illogical character of the plaintiff's reasoning in order to find so-called "equivalents" leads only to a *reductio ad absurdum*; and suggests the applicability here, of Judge Clifford's remarks in *Burr vs. Duryee*, (see page 572, 1st Wallace).

"The (defendants) machine has not one of the peculiar
 "devices or combination of devices, of the Wells machine,
 "nor any substantial identity with it, unless by substan-
 "tial identity is meant every machine which produces the
 "same effect. These abstract phrases, 'substantial iden-
 "tity,' 'equivalent,' 'mode of operation' etc., are often
 "used in such a vague and equivocal manner, that they
 "mystify and lead many to absurd conclusions who will
 "not distinguish between things that differ. * * Now
 "an infringement involves substantial identity. * * It
 "is a copy, either without variation, or with such varia-
 "tions as are consistent with its being in substance the
 "same thing. * * No one who * * inspects the two
 "machines can aver that they contain the same combina-
 "tion of mechanical devices, or substantially the same,
 "to produce the desired effect."

"its equivalent, used in the one is to be found in the other, nor is its mode of operation the same. The argument used to show infringement assumes that every combination of devices in a machine which is used to produce the same effect, is necessarily an equivalent for any other combination used for the same purpose. This is a flagrant abuse of the term 'equivalent'."

Morris J., comparing the two devices said:

R., p. 844. "It appears from * * patent 360,070 that what Westinghouse meant by 'auxiliary valve,' which is made one of the elements of the first and fourth claims, is such a valve * * *which is independent of and performs none of the functions of the main-valve.*"

R., p. 844. "I have not been able to satisfy myself that Boyden makes use of an 'auxiliary-valve' in the sense in which that term is employed in the specification and and some of the claims of the patent 360,070 now in suit."

After acquitting Boyden of infringement of claims 1 and 4, the court considers and quotes claim 2—

"Westinghouse discovered that he could accomplish this result by * * * cause the piston of the triple-valve to make an **unusual** and **further** traverse, and thereby actuate a valve which opened a port by which train-pipe-air was admitted," &c. See Record, p. 843, folio 1363.

Note. We have quoted above, to show that Judge Morris believed that "the further traverse of the piston" was absolutely new in this structure. There can be no doubt that he so believed, and there can be no doubt that he was wrong, and there can be no doubt that he construed claim 2 as not impliedly containing the "auxiliary-valve" of the other claims, and as he had already said (R., p. 844), that defendants do not so use an auxiliary-valve.

one of them do quick-action work by an ingenious reconstruction of the triple-valve chamber entirely novel with Boyden; he could not have held them to have infringed claim 2 upon any construction of the claim which *included* the "auxiliary-valve" as an element.

Given the admission that the paragraph in the decision of Judge Morris above quoted is founded on an error in fact, and *that the further traverse of the piston was old*, and that in the triple-valve of patent 220,556 such "further traverse" was used for the sole purpose of opening wide the *main-valve*, to admit *reservoir-air*, and that such further traverse would have no effect to vent train-pipe air in the machine of patent 360,070 in suit *unless an auxiliary-valve, is added*, located at the terminus of the traverse of the piston and controlling a *separate* or by-passage leading "directly" to the brake-cylinder, the learned Judge's construction of claim 2 is shown to be erroneous, even on his own reasoning, and for which *on these very grounds stated* he was properly reversed. He was properly affirmed as to the claims 1 and 4, because he said, and correctly held, that an essential feature of the Westinghouse machine *as described in the specification* was an "auxiliary" valve, "which is independent of and performs none of the functions of the main-valve of the triple" and that *defendants had no such valve*.

VI. The plaintiff's contention, as gathered from the *quoted* passage on page 3 of their *supplemental* brief, rests upon their view that claim 2 is to be broadly construed to cover "any valve device" brought into operation by the further traverse of the piston, that will vent train-pipe-air directly to the brake-cylinder.

It is respectfully submitted that this is equivalent to asking this Court to reinstate the erased original and rejected 1st claim. The word "valve" in the above sentence "any valve device" is mere surplusage, and the latter is equivalent to the sentence "a device" for the simple reason that the function stated in both

claims is the admission of air, and any device whose function is to admit air, must admit it through an opening or port, and any device controlling an air opening or port is, in the technical sense, a valve. The words "further traverse" in the 2nd claim do not distinguish it, in substance, from the original erased 1st claim, (which did not contain these words), for the reason that both claims expressly include as an element a "triple-valve", such as 220 556, which contains *a piston having both a preliminary traverse and a final traverse in its usual operation*, the former opening its graduating-valve and the latter opening its main-valve. It would be both illogical and contrary to the doctrine of interpretation of patents, to hold that a claim which expressly includes a well-known element specifically referred to as 220,556, having a piston with two well-known movements, might for the sole purpose of distinguishing it from some other claim, be construed as including such an element *altered to have only one of such movements, i. e., a preliminary or partial traverse and never a full one.*

But the plaintiffs contend in their brief (though not in the patent) and *must* contend in order to find identity in any respect whatever with the defendant's device, that the (Westinghouse) invention may be stripped of what they call non-essentials, to wit, a *segregated* passageway, and that, while it must have an auxiliary-valve, such valve need not be physically auxiliary, as shown in the patent, but may be integral *and one and the same* with the main-valve of the triple-valve element; the "gist" of the invention, as they allege, being the provision of a valve, whether it be one of the triples or not, that will admit train-pipe-air, provided it be brought into operation by the "further traverse" of the piston. Aside from the proposition advanced by the defendants, which is incontrovertible and has not been answered by the plaintiffs, that even such a broad construction would be useless and inoperative to produce the result, *without a reconstruction of the valve-chamber* (which the Westinghouse patent

does not teach but which the Boyden patent *does* teach for the first time), there are several reasons why the contention of the plaintiffs is unsound.

First. The plaintiff's contention admits that there must be a passageway for train-pipe-air directly to the brake-cylinder. It will not do to say that the triple-valve-chamber may be such a passageway as is contemplated in the plaintiff's patent. If the latter disclosed for the *first time* a triple-valve-chamber and a separate passageway, one for reservoir-air and the other for train-pipe-air, of course it would not necessarily constitute non-indentity to combine the two in one, but where the reservoir-passage existed before, and where it still exists, and is still used for the same purpose that it was used before, the plaintiff's contention is equivalent to dropping out entirely his passageway when he seeks a construction which includes the old passageway to convey *both* airs to the brake-cylinder.

Second. His contention that the further traverse of the piston contacting with and moving a specifically new valve (not an old one already in the device, but with an added function) is "making the piston on its further traverse perform an added new function," is a perfectly correct contention, and that is exactly the invention patented by Westinghouse, in connection with the separate passageway controlled by such valve. But the further traverse of the piston, *not* contacting with, *but carrying at all times* the old *main-valve*, which is *not* an added valve, but is and always was a part of the "triple-valve" element, and still remains in the triple-valve element to perform its old function of admitting reservoir-air on *the same final traverse* of the piston, is not making the piston (in defendants' apparatus) perform a new function in its further traverse, *simply because, by reconstructing the valve-chamber, such old MAIN-VALVE now also performs an additional function.*

Third. The plaintiff's contention, that the defendants' main-valve, is an auxiliary-valve merely because it performs an additional function on the same further traverse of the piston, by

which its main-valve functions always were performed in the old art, is obviously an argument not that defendant's main-valve is the the *mechanical* equivalent of the plaintiff's auxiliary-valve to perform the new purpose, but that it is the *functional* equivalent.

Judge Hughes states the proposition more neatly in the following language, in his opinion (R., p. 881):

"The performance incidentally of quick action service
 "does not make it (the main-valve) an auxiliary valve. It
 "is the same valve. The incidental service is auxiliary
 "but the valve itself is the same and unchanged."

Non-identity, as a Finding of Fact by Three Tribunals.

Three times by three tribunals in succession, (the Patent Office, the Circuit Court, and the Court of Appeals), have the plaintiffs in the case at bar been told that the defendants' novel, admirable and ingenious mechanism, is the "triple-valve" of the prior art improved as described in Boyden's 1892 patents and now operating to vent both such airs by means of novel changes entirely in the *valve-chamber*, and without any changes in, additions to, or subtractions from, its *old valves* or the old *double traverse* of its piston; and that it does *not* contain the "additional members" or any mechanical equivalent therefor, which Westinghouse added to a "triple-valve" having two valves already and a piston having two traverses, to make up his new "combination", as he calls it, in his letter to the Patent Office.

In view of the burden of proof being on the plaintiffs under the single issue of fact involved, and in face of the *prima facie* presumption against the proposition arising from physical differences in the machines, and in the face of a grant of a patent to defendant on the application in which this precise question of fact was passed upon, and in the face of two decisions by the lower Courts, both finding against the plaintiffs' aforesaid proposition,

it is preposterous to say that this Court should, on the mere ipse
fact of counsel in the brief (aided by their pictorial illustrations
of *imaginary* structures in their brief, but not in the record,
and by obvious misnomer of the vital parts of the machine,
and by obviously misleading coloring of such parts) say that
the plaintiffs have discharged their burden of proof beyond any
reasonable doubt, or will upon such showing reverse the find-
ing of fact by three tribunals in succession, all in perfect
accord with each other, on this most vital and decisive ques-
tion of non-identity.

Respectfully submitted,

HECTOR T. FENTON,

Of Counsel for Defendants.

February, 1897.

BRIEF OF RE-ARGUMENT

—BY—

LYSANDER HILL.

ON BEHALF OF THE BOYDEN BRAKE COMPANY,

“Straight” and Automatic Air Brakes.

As the straight and automatic air brakes have been fully described previously, (pp. 3 to 8 in my former brief), I will only discuss the old triple-valve of the automatic air brake, and then show what Mr. Westinghouse and Mr. Boyden respectively invented and combined with the old triple-valve, by which the train-pipe is vented under each car of its air pressure in order to accomplish the result of quickening the serial application of the several brakes throughout the train.

Two Distinct Old Forms of Triple-Valves.

There are two distinct forms of “triple-valves” known to the air-brake art—distinct not in producing different results or having a different mode of operation, but only in their mechanical construction. The one form employs the *sliding* type of main-valve, while the other employs the *poppet* type of main-valve. These two old forms of triple-valves are represented by the cuts opposite ~~the following page.~~

Comparison of the Two Old Forms.

PASSAGES OR CONNECTIONS.

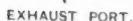
In both forms you will perceive there are passages which connect with the train-pipe; with the auxiliary reservoir; and with the atmosphere.

PISTONS.

In both forms there is a piston whose function is to actuate the different valves in the triple-valve structure

THE OLD SLIDE VALVE FORM OF TRIPLE VALVE.

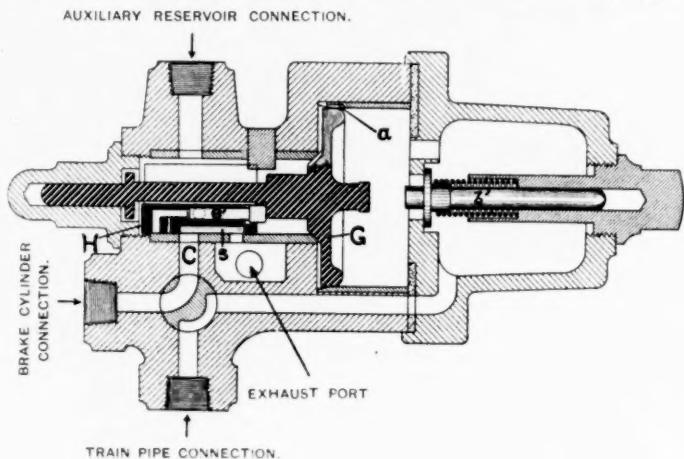
AUXILIARY RESERVOIR CONNECTION.

AUXILIARY
RESERVOIR

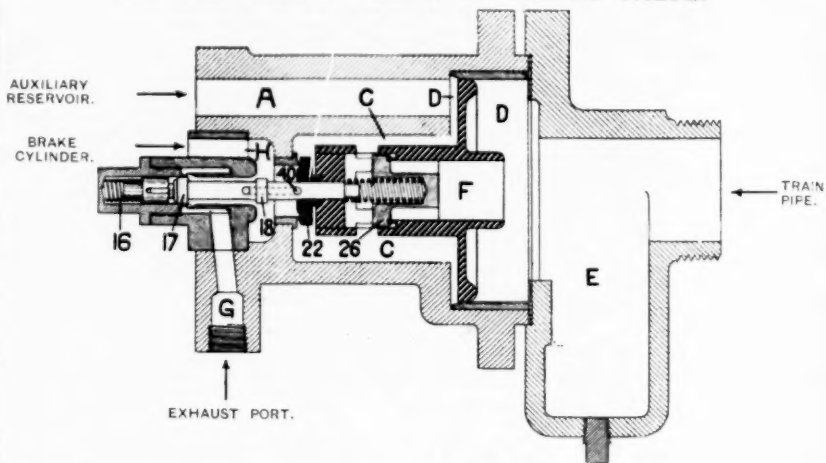
In both structures there are four valves—Feeding-in Valve, blue; Graduating Valve, yellow; Release Valve, green, and Main Valve, black. The valves all functionate as Triple Valves, and it follows that if said valves are "Triple Valves" in the *slide* form, they are also Triple Valves in the *Poppet* form. The piston in both has a "preliminary traverse" and a "further traverse," but the latter is not shown in the *Poppet* form.

Cuts of the Two Large Models Used During the Reargument.

THE OLD SLIDE VALVE FORM OF TRIPLE VALVE.



THE OLD POPPET FORM OF TRIPLE VALVE.



In both structures there are four valves—Feeding-in Valve, blue; Graduating Valve, blue; Release Valve, green, and Main Valve, black. The valves all functionate as Triple Valves, and it follows that if said valves are "Triple Valves" in the *slide* form, they are also Triple Valves in the *Poppet* form. The piston in both has a "preliminary traverse" and a further traverse," the two traverses being old, and used since 1873.

FEEDING-IN-VALVE.

In both forms there is a feeding-in-valve (colored blue), whose function is to control a port by which compressed air is admitted from the train-pipe to the auxiliary-reservoir, where it is stored ready for use.

GRADUATING VALVE.

In both forms there is a sensitive graduating-valve (colored yellow), whose function is to control a *small* port through which the air passes slowly or in graduated amounts from the auxiliary-reservoir to the Brake-cylinder, to *slowly or partially* apply the brakes for ordinary service stops.

RELEASE VALVE.

In both forms there is a release-valve (colored green), whose function is to open a port by which air is discharged from the brake-cylinder to the atmosphere, to release the brakes.

MAIN VALVE.

In both forms there is a main-valve (colored black), whose function is to control a *large* port through which the air passes quickly and fully from the auxiliary-reservoir to the brake-cylinder, to quickly and fully apply the brakes for emergency stops.

SUMMARY OF PARTS OF BOTH FORMS OF OLD TRIPLE-VALVE.

First: Each structure has three passages with like connections.

Second: Each structure has a piston.

Third: Each structure has a feeding-in- valve (blue).

Fourth: Each structure has a graduating-valve (yellow).

Fifth: Each structure has a release-valve (green).

Sixth: Each structure has a main-valve (black).

Operation of the Old Triple-Valve.

TO CHARGE THE BRAKES.

In both old structures the air passes from the train-pipe, shifts the triple-valve piston to the left, then passes through a feeding-in-valve (blue) into the valve-chamber and then to the auxiliary-reservoir.

TO SLOWLY AND PARTIALLY APPLY THE BRAKES.

In both structures when a *small* amount of air is discharged by the engineer from the train-pipe, the pistons make their "preliminary-traverse," and thereby open the graduating-valves (yellow), permitting the auxiliary-reservoir air to slowly, or in graduated amounts, pass to the brake-cylinder to slowly or partially apply the brakes.

RELEASE OF THE BRAKES.

In both structures when the maximum pressure is restored by the engineer in the train-pipe, the pistons are moved to their normal position, to the left, thereby opening the release-valves (green) and discharging the air from the brake-cylinder to the atmosphere and releasing the brakes.

TO QUICKLY AND FULLY APPLY THE BRAKES.

In both structures when a *large* portion of air is discharged by the engineer from the train-pipe, the pistons make their "further" or "full traverse," and thereby open the main-valves (black), permitting the auxiliary-reservoir air to *quickly* and *fully* pass to the brake-cylinder and apply the brakes in the shortest time possible and with the maximum pressure.

Therefore the operation of both these old triple-valve structures is the same; they both produce the same results; they both contain pistons which functionate to operate the different valves, and they both contain the same number of valves (four) which functionate precisely the same in their individual capacity, and as a whole. The only difference

between them is in the mechanical construction of their corresponding valves. In one the *main-valve* is of the SLIDE FORM, whereas in the other the *main-valve* is of the POPPET FORM, but in both the main-valve governs the large or main port between the auxiliary-reservoir and brake-cylinder, and is opened by the "further traverse" of the piston. Therefore, I respectfully submit that if the *slide-valve* (black) is the main-valve in one structure, the *poppet-valve* (black) is also the main-valve in the other structure.

These two triple-valve structures are old, all the patents on them have expired, they are public property and any one can make or sell them, or either of them, without being held liable under any patent.

Complainants' and Defendants' Inventions.

COMPLAINANTS' DEVICE.

[See Cuts opposite following page.]

Mr. Westinghouse took the *slide form* of triple-valve, the structure just described, to which he arranged an "auxiliary-valve device" (colored red), shown in the lower cut opposite, and which is made visible in the small models which your Honors have, by turning down the cover concealing the additional device. This "auxiliary-valve device" consists of:

First: By-passages 43 and 46, whose function is to vent the train pipe under each car, whereby the pressure of the train-pipe is quickly reduced and thereby the application of the several brakes throughout the train made nearly simultaneous.

Second: A valve 41, *auxiliary* to this triple-valve. The function of this new valve is to open and close the said by-passage whereby the venting of the train-pipe air is controlled.

Third: In giving to, or endowing, the old "further traverse" of the piston with, a *new or additional function*, to wit, opening the new auxiliary-valve 41.

OPERATION OF COMPLAINANTS' DEVICE.

With this new device added, the old slide-valve form of triple-valve operates as previously described (see upper cut opposite), but when the piston of the triple-valve makes its "further traverse" to perform its old function of *opening* the main-valve (black), to permit the auxiliary-reservoir air to pass to the brake-cylinder (as shown by the red line, see lower cut opposite), said piston now performs the new function—that of *opening* the additional valve 41 (red), which vents the train-pipe air to the brake-cylinder through the additional passage 46 (as shown by the blue line), which has the effect of quickening the application of the brake on the next car, and so on throughout the train, which results in applying all the brakes of the train nearly simultaneous. Thus, in the complainants' structure, *two* valves are employed, and the piston on its *further traverse* required to perform a new or additional function.

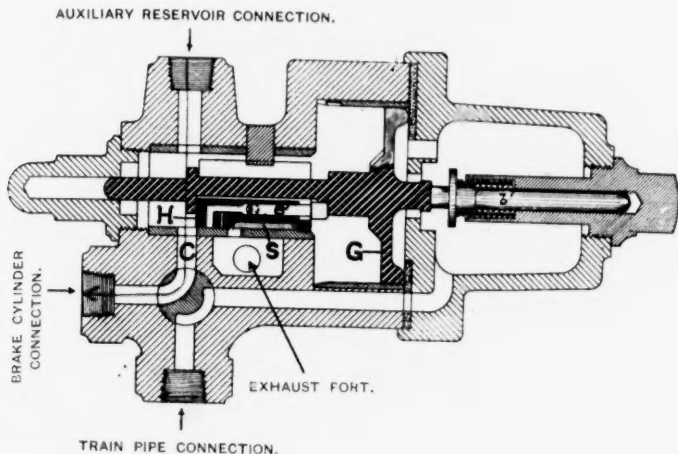
DEFENDANTS' DEVICE.

[See Cuts opposite following page.]

Now, Mr. Boyden took the old *poppet form* of triple-valve just described and perceived, what no man living before him did, that this old triple-valve possessed latent powers that were capable of venting the train-pipe without an additional machine or another valve of any kind, and moreover, that the *further traverse* of the piston need not be called on to perform a *new* function or to do anything more or less than it always had done, and Mr. Boyden's conception was reduced to practice by the most ingenious and simple means imaginable; namely, he merely divided the valve-chamber C from the piston-chamber D by inserting a partition 9.

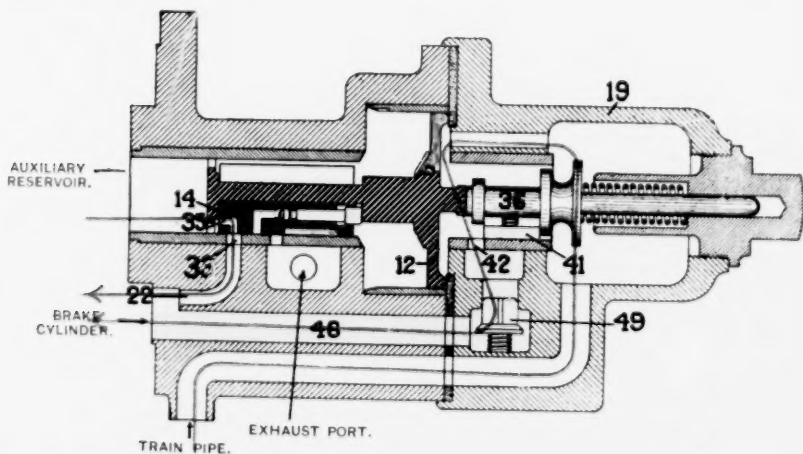
Before this simple change was made the structure was an old plain triple-valve, public property, capable of doing only old triple-valve work. Now, with the *partition* added, it continues to do the same work as before, but it will now also vent the train-pipe. Your Honors will perceive that no passage has been

THE OLD SLIDE FORM OF TRIPLE VALVE, Incapable of Quick Action.



Complainants Structure.

The Old Slide Form of Triple Valve plus the Complainants Second Machine, consisting of an Auxiliary Valve 41, and By-passage 46, shown in Red.

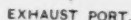


It is therefore seen that the Complainants take the slide form of Triple Valve and combine with it a second machine through which the train-pipe air is vented, and endow the piston with a new function, that of operating the second machine.

Incapable of Quick Action.



**The Old Poppet Form of Triple Valve, made Capable of Quick Action
by inserting Boyden's Partition 9.**



It is therefore seen that Defendants take the old Poppet form of Triple Valve and make it vent the train-pipe air by simply inserting the Partition 9 without requiring a second machine of any kind, or requiring the piston to perform a new function.

added for train-pipe air to pass through; no new valves have been *added* nor does the *piston* perform any new function. The only change made is the insertion of the partition 9.

OPERATION OF DEFENDANTS' DEVICE.

Your Honors will recall that, as a plain triple-valve, when the brakes were to be *quickly* and *fully* applied, the piston of this same structure made its "further traverse," and fully opened the main-valve port for the auxiliary-reservoir air to pass to the brake-cylinder (as shown by the red line, (see upper cut opposite). Now, when the partition 9 is in place, that old operation of the piston and the main-valve is performed just as before, but the partition serves to partially confine the auxiliary-reservoir air in the piston-chamber D and thereby prevents that air from freely passing to the valve-chamber C, so that the previously existing 70 lbs. pressure in the valve-chamber is instantly discharged through the wide-open port of the main-valve and said pressure is thereby reduced to about 5 lbs., whereupon the air-pressure from the train-pipe, at 55 lbs., enters the chamber C (shown by the blue line, see lower cut opposite), and commingling with the auxiliary-reservoir air (shown by a red line), is vented through the *main-valve port*, which results in the quickening of the brakes on the following car. Thus in the defendant's device only *one* valve is used to vent the two airs, and that the old main-valve (black) of the triple-valve, and the piston is *not* required to perform a *new function*.

It is therefore seen that in defendants' structure the only alteration in the old triple-valve is the *insertion of the partition 9* which enables the old triple-valve to vent the train-pipe air.

Defendants' structure therefore does not employ :

First : Any by-passage.

Second : Any auxiliary-valve.

Third : Nor require the "further traverse" of the piston to perform any *new* or *additional* function.

All three of these are the very essence of, and are absolutely required in the complainants' structure. As not one of them is to be found in defendants' structure, evidently, that structure is not the same as complainants.

Comparison of Complainants' and Defendants' Devices.

In the Westinghouse device the old element (triple-valve) is provided with a new and an additional valve device that *functionates* to vent the train-pipe air. The new device is actuated by the "further traverse" of the old piston. Thus, as stated in Claim 2, the piston "*by a further traverse, admits air directly from the main air-pipe to the brake-cylinder.*"

In the Boyden structure no new device is added to the old triple valve element to vent the train-pipe, or to be actuated by the "further traverse" of the old piston. The device Boyden added *functionates* to suddenly reduce the pressure in the valve-chamber, and the train-pipe air then enters said chamber and flows out through the *main-valve* port, which is, and always is, wide open when making an emergency stop with *any* form of triple-valve. In Boyden's device it is true the train-pipe air is admitted to the brake-cylinder *at the moment* the "further traverse" of the piston is made, but this result is produced *not* "by the piston" as in complainants', but by the partition 9.

In other words Mr. Westinghouse's *new device* (the auxiliary-valve 41) *functionates* to do the *new thing* by a preceding action of the old element (the piston), whereas Boyden's *new device* (the partition) *functionates* to enable the *old element* to do the *new thing*.

Certainly here is a radical difference between two inventions to accomplish the same result. The Court of appeals in comparing them remarked, "they seem to us to differ as widely from each other as two devices for accomplishing the same

result can well differ," and this conclusion of that Court is true for the following reasons:

- (a) Westinghouse's added device (the auxilliary-valve) functionates to vent the train-pipe.

Boyden's added device (the partition 9) functionates only to restrict the flow of auxiliary-reservoir air.

- (b) Westinghouse's added device (the auxiliary-valve), is operated by the "further traverse" of the piston.

Boyden's added device (the partition 9), is not operated by the further traverse of the piston, or otherwise, for it remains stationary.

- (c) Westinghouse endows the triple-valve piston with a new function, to wit: opening the new auxiliary-valve to admit train-pipe air.

Boyden does *not* endow the triple-valve piston with any new functions, or call on it to do any thing more than it always did,—it simply opens the same old valves.

With these great existing differences, we submit it is not possible for the device of the defendants to come within any claim the complainant's patent may have.

Comparison of the Two Devices with Claim 1, 2 and 4, Alleged to be Infringed.

Claim 1 is as follows:

"In a brake mechanism, the combination of a main air-pipe, an auxiliary-reservoir, a brake-cylinder, a triple valve, and an *auxiliary-valve* device, actuated by the piston of the triple-valve and independent of the main-valve thereof, for admitting air in the application of the brake directly from the main air-pipe to the brake-cylinder, substantially as set forth."

Now, all the elements named in this claim are old in automatic air-brakes except the "*auxiliary-valve*." In the defendant's device no "auxiliary-valve" is employed, as the old main-valve, black, is used to vent the train-pipe are at the same time

it is performing its old function of venting the auxiliary-reservoir air. Therefore there is no infringement of claim 1, as the only new element in that claim is not found in defendant's device.

Claim 4 is as follows:

"The combination, in a triple-valve device, of a case or chest a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston-stem and governing ports and passages in the case leading to connections with an auxiliary-reservoir and a brake-cylinder and to the atmosphere, respectively, and an *auxiliary-valve* actuated by the piston-stem and controlling communication between passages leading to connections with a main air-pipe and with the brake-cylinder, respectively, substantially as set forth."

This claim is substantially like claim 1, all its elements being old except the "*auxiliary-valve*," and defendant's device not having an auxiliary-valve, is no infringement of that combination for the same reason that applies to claim 1. The Circuit Court and the Court of Appeals for the Fourth Circuit both held that neither claims 1 nor 4 are infringed by the Boyden device.

Claim 2 is as follows:

"In a brake mechanism, the combination of a main air-pipe, an auxiliary-reservoir, a brake-cylinder, and a triple-valve having a piston whose preliminary traverse admits air from the auxiliary-reservoir to the brake-cylinder, and which, by a further traverse, admits air directly from the main air-pipe to the brake-cylinder, substantially as set forth."

Owing to the ambiguity of the language used in this claim it is subject to several different constructions.

AMBIGUITY OF CLAIM 2.

The ambiguity arises from the fact that the combination named in the claim was old. It is simply the old triple-valve device of patent 220,556 and other old triple-valve patents. The two traverses were also old, and it was old to apply the partial traverse for graduating and service stops, and the full traverse for emergency stops.

The only new thing referred to in the claim is indicated by the words: "A piston * * * which, by a further traverse *admits air directly from the main air-pipe to the brake-cylinder.*" The "piston" is the mechanical element here named as the actor; and the words "admits air directly from the main air-pipe to the brake-cylinder," specify merely the function or act performed by the piston. But a *function* is not patentable; and hence the claim must rest squarely on the *piston*, which is said to perform the function.

The piston, itself, however, is old, being nothing more nor less than the piston shown in Fig. 4 of patent 220,556 (R., p. 762); hence, a claim based on the *piston* as the alleged element of novelty cannot stand. The entire combination named in the claim, including the piston, is old; and in the old structures the piston had the same movements that it has here, and under precisely the same conditions. This old combination cannot lawfully be claimed here; and yet, if we read the claim literally, it is the only mechanical thing that *is* claimed here. How, then, shall the claim be construed?

In considering this question, the first thing which arrests our attention is the fact that the combination named in the claim, including the piston, *does not perform the function alleged of it*, and cannot perform it without the aid of other important instrumentalities not mentioned in this claim, viz., the auxiliary-valve 41 and by-passage 42, 43, 46. It did not perform said function, in patent 220,556, because of the absence of these additional instrumentalities; and it does perform it in patent

360,070 because of their presence. They are, therefore, absolutely vital to any proper legal construction of the claim, and must, in some form or other, be construed into the claim; otherwise, the claim is invalid, for the same reason that Morse's eighth claim (*O'Reilly vs. Morse*) was held invalid.

CONSTRUCTION OF CLAIM 2.

We can conceive of only two ways in which the *necessary additional elements* can be construed into the claim, viz., (1) by construing it so broadly as to cover *all possible additional means* which will enable the specified combination to produce the specified result; and (2) by construing it to cover, as implied elements of the combination, *the auxiliary-value 41 and its by-passage*.

Can there be any doubt as to which of these two constructions should be adopted? We think not. The former would bring the claim directly within the inhibition of this Court in *O'Reilly vs. Morse*, 15 How., 62; *Burr vs. Duryee*, 1 Wall., 570, and *The Incandescent Lamp Case*, 161 U. S., as well as under that of the leading English case on this subject, *Neilson vs. Harford*, 1 Webster's Pat. Case, (cited and commented on at length in *O'Reilly vs. Morse*), as being for a "principle," or, in other words, for all possible ways of accomplishing the result, whether they were known to Mr. Westinghouse, or included within the means invented by him, or not. Such a construction would make this Court say, in substance: "The combination that is named in the claim does not do the work; something must be added to it to enable it to accomplish the function; and we will, therefore, construe the claim as covering everything that *can* be added to it for that purpose, whether like the means which Mr. Westinghouse invented or not, and whether now known, or discoverable only by future effort." This Court will never give such a construction to the patent law; for it would overthrow every decision on the subject made in this country or England during the last fifty years. If Sawyer & Man, who

broadly claimed "carbonized *vegetable* fibre" for incandescent lamp filaments (*The Incandescent Lamp Case*, 161 U. S.), were not allowed to cover carbonized *bamboo* fibre, because they had no knowledge of its superior qualities when they procured their patent, how can Mr. Westinghouse be allowed to cover, by the indefinite language of his second claim, devices which he did not invent, and of whose structure and mode of operation he was totally ignorant? The doctrine of *The Incandescent Lamp case* is, that a patentee can cover only what he has invented or discovered, and that if his claims, by the use of broad generalizations, reach out beyond his real discovery, they must be limited back to it by construction. What Mr. Westinghouse invented and added to the old triple-valve, and described in his patent as new, was the auxiliary-valve 41 and its by-passage; and if his second claim reaches beyond this, it should be limited back to it, as was done in *The Incandescent Lamp Case*. This fully protects his rights, and leaves other inventors to benefit the public by discovering other and different means for accomplishing the result.

We are, therefore, constrained to adopt the *second* of the two constructions, which can be given his claim 2, viz., to read the claim as embracing the auxiliary-valve 41. This corresponds to the description contained in the specification, and gives effect to the words "substantially as set forth," found at the end of the claim. It is consistent with the statement of the specification, that the triple-valve

*"is not, therefore, saving as to the structural features
 "by which it performs the further function of effecting
 "the direct admission of air from the main air-pipe to
 "the brake-cylinder, as presently to be described, claimed
 "as of my present invention."* (R., p. 784 L. 12.)

The Patent Office Record Shows that Mr. Westinghouse Himself Placed this Construction on Claim 2.

Mr. Westinghouse's attorney, in his letter, when arguing for the allowance of this second claim, said that the "applicant does not seek to broadly claim a device for admitting air directly from the main air-pipe to the brake-cylinder," but that "when, however, the triple-valve *is provided with an auxiliary-valve, operated by its piston*, which performs a new function, additional to that of the triple-valve as previously employed, it is believed that *such combination is wholly novel*." (R. p. 718, L. 41.) It is consistent with the admission of complainants counsel, p. 41 of their brief, used in the Circuit Court of Appeals, at Richmond, where they said that the "quick-action attachment, consisting of an air-conduit or passage-way, directly from the train-pipe connection to the brake cylinder, *and a valve to control it*,
 * * * *is so made the subject matter of every claim in controversy as to give character and effect thereto*, and render the scope of the claim coextensive with the invention." It agrees with the decision of Judge LACOMBE, in the New York case, who construed the second claim as like the first, but more limited—meaning that the first claim covered the auxiliary-valve, whereas, the second claim covered it only when used on the *final traverse* of the piston—but reading the auxiliary-valve into all of the claims.

So construed, the claim is not infringed by the Boyden device, which has no auxiliary-valve or by-passage, but, on the contrary, has a entirely novel mode of operation, whereby the work is performed by the old plain triple-valve without the aid of anything added by Westinghouse.

THE COMPLAINANTS' CONSTRUCTION OF CLAIM 2.

Complainants' counsel, on p. 22 of their brief at the former hearing in this court, suggested that Westinghouse "availed himself of the capacity of the triple-valve piston for varying

lengths of travel," "to perform a new function," viz., by its final traverse to *open a passage directly from the train-pipe, and thereby charge train-pipe air directly into the brake-cylinder*; and they seem to think that if the second claim be construed as covering the performance by the piston of this "new function," the defendants will necessarily infringe the claim. But in this they are in error, as we will now proceed to demonstrate.

In their assumption that the *Westinghouse piston* performs a new function, they are correct. Prior to the invention of the patent in suit, that piston, in making an emergency-stop by the old triple-valves, performed one function, namely, that of opening the *main-valve* to admit *auxiliary-reservoir air* to the brake-cylinder. In the device of the patent in suit he retained that old function and added the new one of opening also the *auxiliary-valve* to admit *train-pipe air* to the brake-cylinder, thus it now performs two functions.

But, in making an emergency-stop with the Boyden device, the piston performs only *one* function, to wit: its old and well-known function of opening the *main-valve* to admit auxiliary-reservoir air to the brake-cylinder, common to all the old triple-valves. Having performed that function, the piston ceases to act. Now, *that* function does not admit train-pipe air to the brake-cylinder—if it did, the old triple-valves would be quick-action triples, and there would have been no occasion for the new invention of Mr. Westinghouse—and if it did, the Boyden device *with the partition 9 removed* would be a quick-action triple, which it admittedly is not. It is clear, therefore, that opening the main-valve is not the *cause* of admitting train-pipe air. The opening of the main valve merely creates a passage-way from the valve-chamber to the brake-cylinder—the *old passageway*, always created in the same way by the main-valve of the old triple-valves when making an emergency stop. When this passageway is thus created, the train-pipe air will not enter the valve-chamber and flow to the brake-cylinder, *unless*

the pressure in the valve-chamber can be, in some way, reduced far below that of the train-pipe. Now, what causes the pressure in the Boyden valve-chamber to be reduced below the train-pipe pressure, when making an emergency stop? Not the opening of the main-valve, because, when the partition 9 is removed and the main-valve opens to its full extent, in making an emergency stop, the pressure in the valve-chamber *does not* reduce below that of the train-pipe. What, then, is it that reduces the pressure of the valve-chamber to a greater extent than the train-pipe pressure? We answer: Mr. Boyden had the genius to perceive that when the main-valve was open to admit auxiliary-reservoir air to the brake-cylinder, as in all the old triple-valves when making an emergency stop, *if he could choke off the auxiliary-reservoir air from entering the valve-chamber so fast as it discharges therefrom to the brake-cylinder*, he would thereby obtain such a reduction of pressure in the valve-chamber as would enable the train-pipe air to open the check-valve 26 and flow to the brake-cylinder together with the auxiliary-reservoir air; and he inserted the partition 9 to *choke off the auxiliary-reservoir air, and thereby accomplished quick action* by the venting of train-pipe pressure on each car. In this act the main-valve simply performs its old function of opening the passageway; while the partition 9 performs a new function—that of choking off the auxiliary-reservoir pressure from the valve-chamber. When this new function of the partition is superadded to the old one, then quick action takes place; and only then. The new function performed by the piston in the device of Mr. Westinghouse is not a choking-off function, and is not performed upon the auxiliary-reservoir air flowing *into* the valve-chamber; on the contrary, it is a valve-opening function, and is performed upon a sliding piece of metal arranged in the side wall of the drain-cup. The two new functions of Westinghouse and Boyden are, therefore, absolutely different from each

other—nothing could be more so; they are performed upon different materials, and they are performed by different agencies—the one, by the final traverse of the piston acting on the new auxiliary-valve; the other, by the motionless presence ~~of~~ of the obstructive partition having *nothing to do with the piston*, and acting only on the air-pressure in the valve-chamber.

It follows, as before stated, that if we adopt the legal construction of the claim, as suggested in the brief of complainant's counsel, to wit: That it covers all triple-valve devices in which the piston performs the *new function* of the Westinghouse piston, still the defendants' device would not infringe the claim, because (1) its piston performs no *new function*; (2) only the partition 9 performs anything like a new function in the Boyden device; and (3) that function is totally different from the new function of Westinghouse piston, and produces the result by a totally different mode of operation. **Given an old triple-valve, Westinghouse adds a new air-passage, and a new valve to control it and endows the movement of the piston with a new function; given an old triple-valve, Boyden adds a new stationary partition to reduce the pressure in the valve-chamber, but does not endow the movement of the piston with a new function.** How could two inventions be more totally different from each other than these two? And, how can any valid claim be drawn on the one that will cover the other? The vice in the theory of complainants' counsel, relative to claim 2, lies in its ignoring the fact that Westinghouse's piston, in making its "further traverse," performs *two* functions (the old and the new), while Boyden's piston performs only *one* (the old); and that Boyden has discovered how to take advantage of this performance of the piston's *old* function by choking off the access of auxiliary-reservoir pressure to the valve-chamber, and *thus* causing the train-pipe air to enter that chamber and pass to the brake-cylinder. The question is not whether they both effect quick action, for that is only the general result, and not patentable to either; but it is, *how* they

effect it; and, as we have seen, they do the work by entirely different devices and different methods.

Therefore, even if the Court construes the ambiguous language of claim 2 to mean just what the complainants contend for, namely, the "further traverse" of the piston performing a *new function*, by which the train-pipe air is admitted to the brake-cylinder, the defendants' device cannot be an infringement of that claim, as in it the piston *does not* perform a *new function*. But this construction of complainants is not permissible in view of the rejection of claim 2, and its subsequent allowance, as stated in applicant's letter to the Patent Office (R., p. 718, L. 41), that when an "auxiliary valve" is used with the old triple-valve piston, *that* is a novel "combination."

Claim 2 Construed as Including the Double Traverse of the Piston, a Passage-Way and a Valve.

Claim 2 construed as set forth on p. 89 of complainants brief for "(1) the double traverse of the piston, (2) a passage, or way of access directly from the train-pipe to the brake-cylinder and (3) a valve which controls the passage."

This statement of complainants counsel as to what constitutes the "*essentials*" of the Westinghouse structure, we agree is correct as far as it goes, but we add that any statement of "*essentials*" must be *consistent* with the specification. On this important point (*essentials*) the specification is clear and explicit and shows that what complainants' counsel call the "*essential features*" to wit, the passage for train-pipe air and the valve, are expressly stated to be "additional members" to the triple-valve. The specification of the patent says: (Rec. p. 785 last line.)

"the triple-valve accords * * * with my letters-patent * * * 220,556, and in "order that it may perform the further functions requisite in the practice of

"my present invention, it is provided with certain *additional members*, which will now be described. For the purpose of effecting the admission of air directly from the main air-pipe to the brake-cylinder when it is desired to apply the brakes with great rapidity and full force, an auxiliary slide-valve 41 (the red valve) is connected" etc., and a separate passage 46 to the brake cylinder is provided. It is therefore submitted that the "essentials" must consist of "additional members" *added* to the *old* triple-valve.

We do not contend that claim 2 should be limited as complainants say "by a *slavish* adoption of the *identical* instrumentalities" described in the specification, on the contrary we say construe the claim as broadly as possibly consistent with the specification of the patent, to wit: a valve and passage-way of any form or character which are "additional members" to the *old* triple-valve. These are what Mr. Westinghouse describes as his new devices and claim 2 so construed will be co-extensive with his invention.

Defendants device does not infringe claim 2 thus construed because the valve and passage employed are *old* triple-valve parts, and in no sense "additional members" of the triple-valve, and therefore not within the claim 2 under this construction.

Complainants' Contentions Answered.

COMPLAINANTS' CONTENTION AS TO DEFENDANTS' MAIN-VALVE 22
BEING THEIR AUXILIARY VALVE.

The complainants realizing that they are compelled to find an auxiliary-valve in the defendants' devices try to do so by specious arguments and theories, contending that the defendants' OLD POPPET FORM of main-valve is the new AUXILIARY-VALVE of the patent in suit. But this Old Poppet Valve (Black) was in triple-valves as early as in 1873. (See Patent No. 141,685, R-, p. 736). Its function therein was to admit the auxiliary-reservoir air to the brake-cylinder, a function

which it still performs in the defendants' device; but now, because the same valve admits the train-pipe air while it is admitting auxiliary-reservoir air, they say it becomes a new and auxiliary-valve. The Court below, in defining this valve, stated:

"In the original triple-valve it performed no other service than admitting auxiliary-reservoir air into the brake-cylinder; in Boyden's device it continues to perform that service, and is made incidentally instrumental in allowing the passage of train-pipe air. The performance incidentally of quick-action service does not make it an auxiliary-valve. It is the same valve. The incidental service is auxiliary, but the valve itself is the same and unchanged." (R., p. 881.)

And that statement of fact is obviously absolutely true.

WHY IT IS THE MAIN-VALVE.

In all triple-valves used since 1873 to the present time the main-valve thereof is located on the auxiliary-reservoir-side of the piston, so that when closed, it prevents auxiliary-reservoir air from passing to the brake-cylinder, and when opened admits the auxiliary-reservoir air to the brake-cylinder. Now, this is just where the defendants' POPPET-VALVE 22 (black) is located, and is just what it does when closed and what it does when opened. It was the MAIN-VALVE before the partition 9 was put in the device, and the insertion of the partition cannot make the MAIN-VALVE that existed before in the structure an auxiliary or additional valve, and this fact has been three times so decided.—First, by the Patent Office (R., p. 815, L. 23); second, by Judge Morris, of the Circuit Court (R., p. 845, L. 2); and, third, unanimously by the Circuit Court of Appeals for the Fourth Circuit (R., p. 881, L. 40).

COMPLAINANTS CONTEND THAT THE DEFENDANTS' PARTITION 9 IS FOUND IN THEIR STRUCTURE AND IS OLD.

This contention is absolutely untrue, as the complainants' structure does not contain a partition to divide the valve chamber C from the piston chamber D. If the complainants' device

has such a partition, why the necessity of the "additional members," consisting of a by-passage and auxiliary-valve? And why is it that the piston therein has to do more work, by performing an additional function, than it did before? No; Boyden's partition is not found in complainants' device.

The complainants are trying to deceive the Court by a specious argument that the port 35 and the end of the main-valve 14 is the equivalent of Boyden's partitions; but are those things of complainants *located* between the piston-chamber D and valve-chamber C? No. Or, do those things make the triple-valve *per se* vent the train-pipe in the complainants' device? No. The fact is, that counsel for complainants realize the controlling character of defendants' *partition* 9, and are simply trying, by specious arguments, to make the Court believe that it is not new with Boyden, and that it is found in complainants' structure.

BOYDEN'S PARTITION NEW.

As to its being, new, no one can point to a triple-valve in the whole prior art that contains *such* a partition, one that will confine the air in the piston-chamber D and cause the air-pressure to be *lowered* in the valve-chamber C, so that the triple-valve will vent the train-pipe air by such an operation. This partition 9 was absolutely new with Boyden. It was *broadly* patented to him on his application, dated September 30, 1889, (R., p. 799, L. 5,) *before December* 12, 1889, *when this suit was brought*; therefore, their allegation on page 5 of their brief is untrue.

ALL TRIPLE-VALVES HAVE SOME KIND OF PARTITION.

It is true all triple-valves have partitions; the piston is a partition, all the valves are partitions, the dividing walls are partitions, but no partition operating like Boyden's is found in any prior triple-valve or in any structure that complainants have; a partition that will endow the triple-valve with capabilities to vent the train-pipe *without adding any valves* or changing its old function, and not requiring its piston to perform a

new function or to do one thing more or less than it always did. That kind of *partition* is nowhere found in the whole art except in the Boyden invention.

CREDIT DUE MR. BOYDEN.

To Mr. Boyden is due the credit that the art is advanced one more step by the invention of a partition inserted in the triple-valve chamber by which additional valves and passages are dispensed with and the prior quick-action structure is simplified one-half, whereby fewer parts are required to be kept in order, fewer parts to be replaced, and a greater certainty of action when the apparatus is called on to prevent the loss of life and the destruction of property.

THE CAPABILITY OF BOYDEN'S PARTITION.

That partition is a very simple and small thing, but its capabilities are great; by it the latent powers of the triple-valve are made available; by it the old emergency application of the triple-valve is changed; by it the *additional* member of the patent in suit or of a "second machine" of any character are entirely dispensed with and the piston not required to do additional work.

In the Boyden structure the feeding-in-passage from the train-pipe through the piston to the valve-chamber, and thence to the auxiliary-reservoir, is to be regarded as always open inward towards the valve-chamber, but checked by the check-valve 26 against backward flow into the train-pipe. The Boyden piston, with its check-valve, is borrowed bodily from the old Boyden patent of June 26, 1883, No. 280,285, where it will be found illustrated in Fig. 3 of the patent drawings. (R., pp. 448 and 776). An inventor naturally prefers his own creations, and Boyden preferred his own old form of piston, with its central check-valved feed-passage, and its tubular inward extension or stem. In Boyden's patent of June 26, 1883, four years before the patent in suit, he applied to this check-valved central

feed-passage the term "an always-open, one-way passage;" and it is a construction which Mr. Westinghouse expressly disclaims in the disclaimer which appears in the specification immediately before the claims of the patent in suit. (R., p. 788.)

Now, if the check-valve of this passage be omitted from the Boyden device here in suit, the passage will be absolutely open between the train-pipe and the triple-valve chamber at all times, and in both directions; *but the device will still perform quick-action on the emergency-stop, just as before*, the office of the check-valve being merely to prevent air from passing backward into the train-pipe, and not to prevent it from passing forward from the train-pipe to the valve-chamber. Without the check-valve 26, the device will not operate to graduate, or for service stops, because the auxiliary-reservoir air will escape backwards into the train-pipe. But in making an emergency-stop, the auxiliary-reservoir air has no time to flow back into the train-pipe before the piston is drawn back through its full traverse; and, as the partition chokes off the flow of auxiliary-reservoir air to the valve-chamber, the reduction of pressure thereby affected in the latter chamber allows the train-pipe air to press forward into said chamber, just the same without as with the presence of the check-valve. We mention this fact to show that it is the partition 9 to which the whole credit of quick-action in the Boyden device is due. True, the partition alone will not produce quick-action; *but when added to an old triple-valve capable of performing its old and usual functions, the partition 9 will superadd the function of retaining the train-pipe air for quick-action.*

COMPLAINANTS CONTEND THAT THE BOYDEN DIFFERENTIAL PRESSURES ARE FOUND IN THEIR STRUCTURE.

This is absolutely untrue; of course all tripe-valves, in operating, must have differential pressure, but none have those differential pressures which are produced in the operation of the Boyden structure. Namely: First, retaining 70 lbs. pressure in

the piston-chamber D; second, *reducing* the prior 70 lbs. in the valve-chamber C to 5 lbs. pressure at the instant that the pressure in the train-pipe is at 55 lbs. and thereby uniting the train-pipe and auxiliary-reservoir pressures in the triple-valve chamber and simultaneously venting them together through the port opened by the old main-valve of the triple-valve. (See card 6, with model of defendant's structure.) *This* kind of differential pressure never existed in any triple-valve prior to Boyden's invention, nor does it exist in the complainants' structure. Nowhere have complainants pointed out in their structure that the maximum pressure of 70 lbs. in the main-valve chamber is *reduced* from 70 lbs. to 5 lbs., and thereby *make the main-valve of the old triple valve vent the train-pipe pressure* at the instant it vents the auxiliary-reservoir pressure. These are the Boyden differential pressures: and they are not found in the operation of the complainants' structure.

COLORING THE SEVERAL VALVES DIFFERENTLY.

When this case was first presented in the Circuit Court the defendants adopted the method of coloring the corresponding valves in the defendants' and complainants' structures the same color, and applying a different color for each kind of valve; they also used this method before the Circuit Court of Appeals, the object being to assist the Court in quickly distinguishing the different valves without great labor on their part of tracing the different and numerous lines that form the boundary line of the valves. The complainants did not adopt this system in the lower Courts, but finding that it clearly enlightened the Courts as to just what the different valves were, they have for the first time adopted it before this Court. Now they have a perfect right to do so, but *they use the colors to complicate* and confuse the two structures by omitting and not coloring the corresponding valves alike. For instance, in the cuts of their device opposite page 22 of their brief, they properly color the valves. That is to say, the *release-valve* (green), the sensitive

graduating-valve (yellow); the main-valve (black) and the auxiliary-valve (red) which vents the train-pipe air, but they failed to color the feeding-in valve, blue (see same colored, opposite page 18 of my original brief).

But when they color the valves in the defendants' device, opposite pages 39, 40 and 78, they do not color the feeding-in valve (blue) nor the sensitive graduating-valve (yellow) Now, why did they not frankly put the proper color on all the valves in both structures? The reason is, that if they colored the sensitive graduating-valve 18 in the defendants' structure, yellow, they would have to color the main-valve, 22, black, and therefore there would be no valve left to be colored red, that would correspond to their new auxiliary-valve 41; a procedure that is specious and misleading, and intended to befog rather than elucidate the subject under controversy.

THE COMPLAINANTS' METHOD OF COLORING PROVED TO BE
ERRONEOUS.

Their erroneous method of coloring the valves is conclusively proved by numerically comparing the valves in both structures.

COMPLAINANTS' STRUCTURE.	DEFENDANTS' STRUCTURE.
First: Feeding-in valve (blue).	First: Feeding-in valve (blue).
Second: Release valve (green).	Second: Release valve (green).
Third: Graduating valve (yellow).	Third: Graduating valve (yellow).
Fourth: Main valve (black).	Fourth: Main valve (black).
Fifth: Auxiliary-valve (red).	(No fifth valve).
Making five in all; four belong to the old triple-valve and one belongs to the <i>new</i> machine.	Making four in all, and all of which belong to the old triple-valve.

Therefore it is obvious that complainants' red color on the main-valve in the defendants' structure, to show that it is an

auxiliary-valve, has no justification, and is absolutely misleading and erroneous.

THE NUMEROUS IMAGINARY VALVES ALLEGED TO SHOW MODIFICATIONS OF COMPLAINANTS' STRUCTURE.

The complainants have inserted cuts of numerous imaginary valves in their brief for the purpose of trying to break the force of defendants' coloring. Now these imaginary valves are not in the record. There is no testimony pertaining to them nor have the defendants had an opportunity to rebut the statements pertaining thereto, and therefore they should be considered with great caution if considered at all by the Court.

It is a conspicuous fact about these numerous valves which purport to show that the complainants' and defendants' structures are substantially the same, that in those shown opposite p. 62, of plaintiffs' main brief, which are minus the Boyden Partition 9 dividing the valve-chamber from the piston-chamber, *two* valves and a by-passage are required to vent the two airs; i. e., a red valve to vent the train-pipe air and a black valve to vent the auxiliary-reservoir air; and those opposite p. 64, that show one valve venting the two airs without any by-passage *have* the Boyden Partition 9. Therefore these very imaginary valves prove that by the use of the Partition 9 *one* valve is made to perform the two functions, and where the partition is not shown, *two* valves are required, and this is just where the difference is between the two inventions. In other words, Westinghouse uses the old main-valve (black), of the triple-valve to vent the auxiliary-reservoir air, and a *new* valve (red), to vent the train-pipe air; whereas Boyden uses only the old main-valve of the triple-valve to vent *both* the auxiliary-reservoir air and train-pipe air. (See card 6, small models of defendants' device.)

Designate, color, or arrange these as you may, when you find one valve venting the two airs, *that* is Boyden's invention, and where you find two valves venting the two airs that



FOLDOUTS TOO LARGE TO
BE FILMED

is Westinghouse's invention. This rule is infallible and distinctly defines the difference between the two inventions, and should they be put into a hundred different imaginary forms the two inventions can be immediately distinguished by the application of this rule.

It is submitted that it is opposed to common sense to multiply indefinitely the structures by inserting cuts of imaginary forms that only tend to confuse instead of shedding light on the subject, and that, too, by imaginary forms that have not been *testified to*.

Patent 360,070 Not a Pioneer or Meritorious Invention.

The complainants in order to get a broad and general construction of the patent in suit, and to impress the Court with its alleged merit and magnitude, have endeavored to establish a "pioneership" for it that is wholly specious and not consistent with the facts of history pertaining thereto.

To construe the claims of the patent in suit as liberally and broadly as the circumstances and language of the claims will permit, is proper, and is but justice to the complainants; but in view of the failure of this device to solve the problem of quick-action air-brake, to give the patent undue credit as a meritorious invention, and then use that credit as a reason for expanding the claims, would be a wrong to both defendants and to the public.

EXHIBIT OF 1879, 1887 AND 1888 PATENTS.

The illustrations on folded insert show just where the patent in suit stands as to pioneership and just how meritorious it is.

PATENT OF 1879—DISCLOSING THE FUNDAMENTAL LAW OF QUICK-ACTION.

The drawing to the left represents the device which disclosed the fundamental law of consecutive quick-action, and that law is applied in every quick-action brake of to-day. It was patented

in 1879, in the United States, by Mr. Westinghouse. It consists, first, of a train-pipe; second, an auxiliary-reservoir; third, a brake-cylinder; fourth, triple-valve, all of which are old and constitute the plain automatic brake, and in order to quicken the serial application of the several brakes in a train, it has combined with it an *auxiliary-valve*, colored red, to vent the train-pipe, and a supplemental-piston, colored brown, to actuate the auxiliary-valve. Now, in its operation when a quick-action is to be made, sufficient air is discharged by the engineer from the train-pipe to move the piston of the triple-valve its full stroke and open the main-valve (black) to fully apply the first brake with auxiliary-reservoir air, the course of the air being shown by a red line, and at the same time this discharge of air by the engineer moves the supplemental piston (brown), which opens the auxiliary-valve (red) at each car and vents the train-pipe air, its course being shown by a blue line, resulting in effecting the quick application of the brake on the following car, and so on throughout the train, producing a nearly simultaneous application of the several brakes. (R., p. 759, L. 42.)

THE UNSUCCESSFUL DEVICE OF THE PATENT IN SUIT OF 1887.

Now, in 1886 or 1887, Mr. Westinghouse took this fundamental law of 1879 and applied it in the device of the patent in suit, shown in the central figure. In the 1879 device the auxiliary-valve device (red) was actuated by a supplemental piston, but in the 1887 device the supplemental piston was dispensed with and the auxiliary-valve located in the triple-valve casing, in such relation to the piston thereof that the latter was endowed with a new *function* simultaneously with the performance of its old function of opening the main-valve (black) to vent the auxiliary-reservoir air, shown by a red line. The new function consists of opening the auxiliary-valve (red) to vent the train-pipe air, shown by a blue line, thereby resulting in quickening the action of the following brakes in the train, the

same as in the prior device of 1879, except that the auxiliary-valve (red) in 1887 is actuated by the triple-valve piston instead of by a *supplemental* piston, as in 1897. Now, this 1887 device on public trial at Burlington, Iowa, in 1887, failed to apply the brakes throughout the train sufficiently quick, and produced worse shocks than before, and therefore was unsuccessful. (R., p. 128, L. 12.)

THE SUCCESSFUL DEVICE OF 1888. (AT RIGHT HAND OF FOLDER.)

Mr. Westinghouse then constructed the successful device of patent January 21, 1888, not in suit, shown to the right, and again reverted back to his 1879 patent, and in addition to adopting the auxiliary-valve (red) thereof, he also at last adopted the *supplemental* piston (brown) thereof, and combined the *two* with the old triple-valve, so that when the brakes were to be quickly applied, the auxiliary-reservoir air, shown by a red line, was admitted to the brake-cylinder by the main-valve (black), and also to the chamber containing the supplemental piston (brown), and that piston opened the "auxiliary-valve," which vented the train-pipe air, shown by a blue line. With this combination, which is not in suit here, he obtained satisfactory results.

Now, from this history, it is quite obvious the patent in suit was *not* the first to disclose the fundamental law of serial quick-action, as that was made known in 1879 by patent No. 217,838 (R., p. 759), nor was it the first to practically apply *that law*, as that was accomplished in 1888 by the device of the patent No. 376,837 (R., p. 131, L. 12). Therefore, the complainants' contention that the patent in suit is a great, meritorious and pioneer patent is erroneous, and not well founded.

FUNDAMENTAL LAW DISCLOSED PRIOR TO THE
WESTINGHOUSE 1879 PATENT.

Furthermore the fundamental law shown in the 1879 patent to Mr. Westinghouse was not first disclosed by him, as it was

first patented in England (R., p. 68, line 7), March 12th, 1879, No. 980, by Sanders. Mr. Westinghouse was in England about that time, as his signature to the specification of the United States patent, No. 217,838, was witnessed at 17 Grace-Church street, London, E. C. (R., p. 761), and his application for the United States patent was filed May 21st, 1879, (R., p. 759, L. 4), two months after the English patent was published to the world.

VENTING THE TRAIN-PIPE AIR TO THE BRAKE-CYLINDER DIS-
CLOSED PRIOR TO THE WESTINGHOUSE PATENT OF 1887.

Nor was Mr. Westinghouse the first, in the patent in suit, to vent the train-pipe air into the brake-cylinder, to augment the pressure therein, as that was done by Mr. Boyden and patented to him June 26, 1883, and that patent was the cause of the rejection and erasure of Mr. Westinghouse's broad claim from the patent in suit. (R., p. 717, L. 18).

WHY THE DEVICE OF PATENT IN SUIT WAS UNSUCCESSFUL.

Now, let us see why the device failed. It will be observed that the first device of 1879, and the last, the successful device of 1888, both use auxiliary-valves, but actuate them by *supplemental* pistons; whereas the intermediate device of patent in suit does not use any supplemental piston, but uses the *old further traverse* of the piston to actuate the auxiliary-valve, thereby requiring the said piston to perform a new and *additional function*, or perform the double duty of opening the main valve (black) of the triple-valve to vent the auxiliary-reservoir air, and also opening the *auxiliary-valve* (red) to vent the train-pipe air. This double work necessarily makes the piston move slowly and requires a greater reduction of train-pipe air to actuate it, which results in a piston action *too slow* to sufficiently quicken the application of the brakes throughout the train, therefore *this double work of the piston* is what caused the failure of the device of the patent in suit. This defect was

remedied in the 1888 patent by utilizing the supplemental piston, and thus relieving the triple-valve piston of the extra work.

A SIGNIFICANT FACT.

It is a significant fact that when "auxiliary-valves" are used *successfully* a supplemental piston is used to actuate them, and this fact proves that the defendants' device does not use an auxiliary-valve, and that the main-valve 22 is *not* an auxiliary-valve, because, if it were, the piston would have to perform an *additional function*, and to do double work, and thereby the defendants' device, which has proven successful, would be impracticable, for the reason that the device of patent in suit was unsuccessful.

COMPLAINANTS' EXCUSE AS TO FAILURE OF THE
PATENT DEVICE IN SUIT.

The complainants explain that the failure of the patent in suit was due to no inherent defect, but to the small size of the ports of the valves, and that when the ports were made larger the device worked substantially as well as the 1888 patent, where a supplemental piston is used. Now, there is no testimony which sets forth where and when this was tried or proven to be true, and the fact remains that if it is true, why do the complainants complicate their successful device with a supplemental piston when so simple a thing as *making a port larger* would remedy the defect? The physical facts are, that if they made the port under the auxiliary-valve larger the air-pressure on that valve would be increased, and consequently the resistance to its movement would be increased in the same ratio, thereby resulting in making the piston of the triple-valve move still more slowly, requiring a greater reduction of train-pipe pressure and the brakes would be more retarded than if the ports were the size shown in the patent. The records shows that they experimented with the device of patent in suit several months after its failure at the Burlington trials (R., p. 148, X-Q. 159) and at

last accomplished the desired result only when they reverted back to the supplemental piston of 1879 patent. Their allegations are wholly inconsistent with the facts disclosed by the records and with physical reasons herein given.

COMPLAINANTS' CONTENTION AS TO THE QUICK-ACTION
DEVICE OF 1879 BEING INOPERATIVE.

The records show that the defendants made fifty of the devices of the patent No. 217,838 of 1879 and tested them on a rack equipped with fifty brakes, just as in practice, and the devices *did work as set forth in the patent* (R., p. 669, L. 37), and did greatly quicken the action of the brakes and that they were operative. Now, on the other hand, what does the record show about the operation of the device of patent in suit? It proves that it was a failure (R., p. 126, L. 26), and it required great inventive skill and several months' work to accomplish the result, and then it was not by the device of patent in suit, but by another device for which they procured the 1888 patent. It is therefore submitted that if, according to complainants' contention, the first device (1879) was inoperative, and therefore should not be favorably considered, why should the second device (1887) receive favorable consideration since it was proven to be a failure, and is not now used, and never shown in their catalogues (R., p. 149, L. 31). The device of 1879, at least, has the credit of being the first in the United States to show the fundamental law of quick-action, and to show a *supplemental piston* actuating an auxiliary-valve, which are embodied in the successful device of 1888; but the *actuating* of the "auxiliary-valve" by the triple-valve piston, *the leading thing of the patent in suit*, and which the complainants set such stress on here, is not used at all by them or any one else, nor has it ever been used since its failure at Burlington in the spring of 1887.

In calling the attention of the Court to the patent of 1879, which discloses the fundamental law of serial quick-action, and

to the fact that the patent in suit was inoperative to produce the result sought for, and to the other matter just referred to; it is not for the purpose of belittling the patent in suit, but this is done for the purpose of rebutting the great pretensions of counsel as to the *merits* and *pioneership* of that patent, and their efforts to have it construed for something more than the facts surrounding it warrant.

SUMMARY.

First: That the complainants' invention consists of the old automatic brake plus a second machine consisting of: (A) an additional passage; (B) an auxiliary-valve controlling the said passage; and (C) endowing the triple-valve piston with a *new or additional function*: i. e., to actuate the said auxiliary-valve.

That the defendants' device does not contain an additional passage or an auxiliary-valve or use the piston to perform a *new or additional function*: and, therefore, is for a wholly different invention, and does not come within any claim of the patent in suit.

Second: That the complainants' contention and assertions as to the patent in suit being meritorious and pioneer, are fallacious and not supported by acts, for instead of possessing these qualities, that device is simply an unsuccessful patent which does not possess even the merit of being the first to disclose the fundamental law of quick-action, nor of being the first to reduce that law to practice and, therefore, should not be construed by this Court to be for anything more than just what it fairly describes.

Third: That the defendants' invention is meritorious as being the first to disclose that the triple-valve *per se* possessed in itself latent powers to vent the train-pipe air without complicating the automatic-brake system with additional or auxiliary-valve devices of any kind; and further, that this great change was brought about by the most simple means imaginable (Partition 9). A device that cannot get out of order, that needs

no repairing, and which is absolutely sure to act when called on in emergency to prevent loss of life and the destruction of property.

Fourth: To hold the defendants' device an infringement of the *unsuccessful* and the *unused* (R., p. 149, L. 36), device of the patent in suit would tend to discourage rather than encourage progress in mechanical art, and, furthermore, not only prevent the railroad companies from using a device that had advanced the art one step forward, but would maintain a monopoly that last year netted over two million, six hundred thousand dollars profit, and cut the railroad road companies off from the benefit of competition in supplying themselves with air-brakes, which, by law, they are required to use, and that, too, by a patent for a device which the railroad companies decided *not* to use after being tested by the most proficient experts in the country, the Master Car Builders' Committee, who reported, in 1887, after the test at Burlington of the device of the patent in suit, that "the field for improvement was open as wide as in 1886." (R., p. 126, L. 26).

Fifth: We consider that it is proper and just to construe the claims of the complainants' patent so as to cover the invention described therein; but should not be expanded so as to cover the defendants' device, which does not use the invention described in the complainants' patent as a whole or in one detail, and which operates by an entirely different mode of operation.

Respectfully submitted,

LYSANDER HILL,
Of Counsel for Defendants.

APPENDIX

IN ANSWER TO

PLAINTIFFS' SUPPLEMENTAL BRIEF.

Further Traverse of the Piston.

The great theme of complainants' counsel is, the utilization of the "further traverse" of the triple valve piston to do work that it never did before, by which great and beneficial results are accomplished. For the first time in this litigation they now concede before this Court that the *further traverse* is old, but they say it possessed defects, and Mr. Westinghouse's "remarkable invention in suit converted the cause of difficulty into an element of success." On page 3 of supplemental brief they solicit the admiration of the Court, when dilating on the further traverse, by stating that—

"Such triumphs in mechanics are only achieved by those whose genius is of the supreme quality which enables a commander to snatch victory from defeat."

And Mr. Betts, in the most impressive manner, told this Court in substance at the prior argument, that—

‘When in case of an emergency, as when a draw-bridge was open or a switch misplaced, or some deadly danger ahead, that then the engineer, by the means at his control, could utilize the further traverse of the piston *‘to perform a new function’*—to do work it never did before, and thereby vent the train-pipe air, which instantly causes the brakes to be applied throughout the train with lightning-like rapidity, and with the greatest available force, resulting in saving the lives and limbs of numerous passengers, and the property of the railroad company; and that the utilization of the *‘further traverse of the piston to do work that it never did before* is the great and underlying principle of Mr. Westinghouse’s invention, and one that well deserves a broad and liberal construction by the Courts; and as claim 2 more *nearly* covers that invention, it should not be limited ‘by a *slavish* adoption of the *identical* instrumentalities shown.’

Now, the alleged facts set forth in this argument can safely be conceded by defendants, for the very reason that this great and underlying principle contended for—to wit, the further traverse of the piston “*performing a new function*” and doing work that it did not do before, by which train-pipe air is vented, **is not used by defendants**. And further, this very point forms the parting of the ways between the complainants’ and defendants’ respective inventions.

Mr. Westinghouse took the old triple-valve (patent 220,556) and when the piston made its old “further traverse” to open the main-valve (black) to admit auxiliary-reservoir air to the brake-cylinder for emergency applications of the brakes, as it always did, he utilized that old further traverse of the piston and caused it to do *additional work*, that of opening an auxiliary-valve which did not previously exist in triple-valves, to

vented the train-pipe air, thereby Mr. Westinghouse endowed the *further traverse* of the piston with "*a new function*."

Now Mr. Boyden in order to reach the result of venting train-pipe air, proceeded on a very different principle from that of utilizing the "*further traverse*" of the piston to do additional work or to "*perform a new function*." He took the old triple-valve and when the piston made its old further traverse to open the main-valve (black) to admit auxiliary-reservoir air to the brake cylinder for emergency applications of the brakes, just as it always has done, he modified the old triple-valve chambers by *inserting a partition*, whereby the maximum air-pressure of 70 lbs was reduced to 5 lbs. in the main-valve chamber, and thereby the train-pipe air is vented through the main-valve simultaneously with the venting of auxiliary-reservoir air, thus not requiring the "*further traverse of the piston*" to do any thing more or less than it always had done. Consequently, conceding as true what counsel for complainants say, as to claim 2 being broadly for the further traverse of the the piston "*performing a new function*" of opening a port, or doing anything else imaginable, more than it did before, by which train-pipe air is vented, the defendant's device, not operating so that the further traverse of the piston "*performs a new function*," cannot be held an infringement of that claim.

Misleading Cuts.

Another procedure of complainants' counsel which calls for serious comment, is the introduction of cuts representing imaginary devices not in the record. These cuts and accompanying statements are essentially misleading. This was resorted to, to a very large extent, in their main brief, but in their supplemental brief they introduce *incomplete* cuts which they pretend represent the different positions and actions of the defendants' valves, but which are wholly erroneous.

Plaintiff's Counsel's Imaginary Valve Positions.

Opposite page 8 plaintiffs' supplemental brief, they show the upper cut opposite, as representing the valves of Boyden structure in the "graduated" position.

It will be noticed that the graduation valve-port (40) is only slightly open with reference to the main-valve, 22, so that air, shown by a red line, can barely enter. This position is absolutely erroneous as the Boyden "graduating valve" never takes any such position. In graduating the small port (40) is open full, as shown by the lower cut opposite, which is the same as shown opposite page 10 of complainants' supplemental brief, which they allege is the position for a "full" application of the brakes.

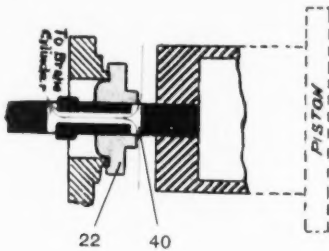
The alleged position in the upper cut is *never* taken, and the position shown in the lower cut is the one *always* taken *for graduation*, and the reason that the small port will never partly open as alleged is, that when the piston once starts to move towards the train-pipe it will not stop until the shoulder of the stem comes in contact with the main-valve, 22, as shown in the lower cut, consequently the port in the graduating valve is always open to its full capacity when graduating.

By this newly-created position (existing nowhere except in the minds of plaintiffs' counsel), of defendants' graduating valve partly opening the port 40 to graduate the brakes shown in the upper cut, the piston would necessarily make its "preliminary traverse;" then to open the graduating port wide for a "full" application of the brakes, shown in the lower cut, the piston would have to make the "further traverse." Now as there are only *two* "traverses" to the piston, we ask how is the main-valve 22 to be opened? The ingenious counsel for Complainants should have invented a *third* traverse to open valve 22, in order to get their erroneous allegations out of this predicament. They have not seemed to realize this, or possibly they did, and this last view might account for the abridgment of the

Cut from Plaintiff's Supplemental Brief.

(Opposite Page 8)

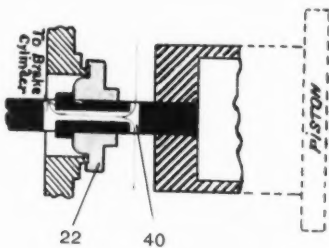
Alleged to represent the graduated position of defendant's Graduating Valve but which position in fact never exists, as port 40 is never partially opened as it always remains full as shown in the lower cut.



Cut from Plaintiff's Supplemental Brief.

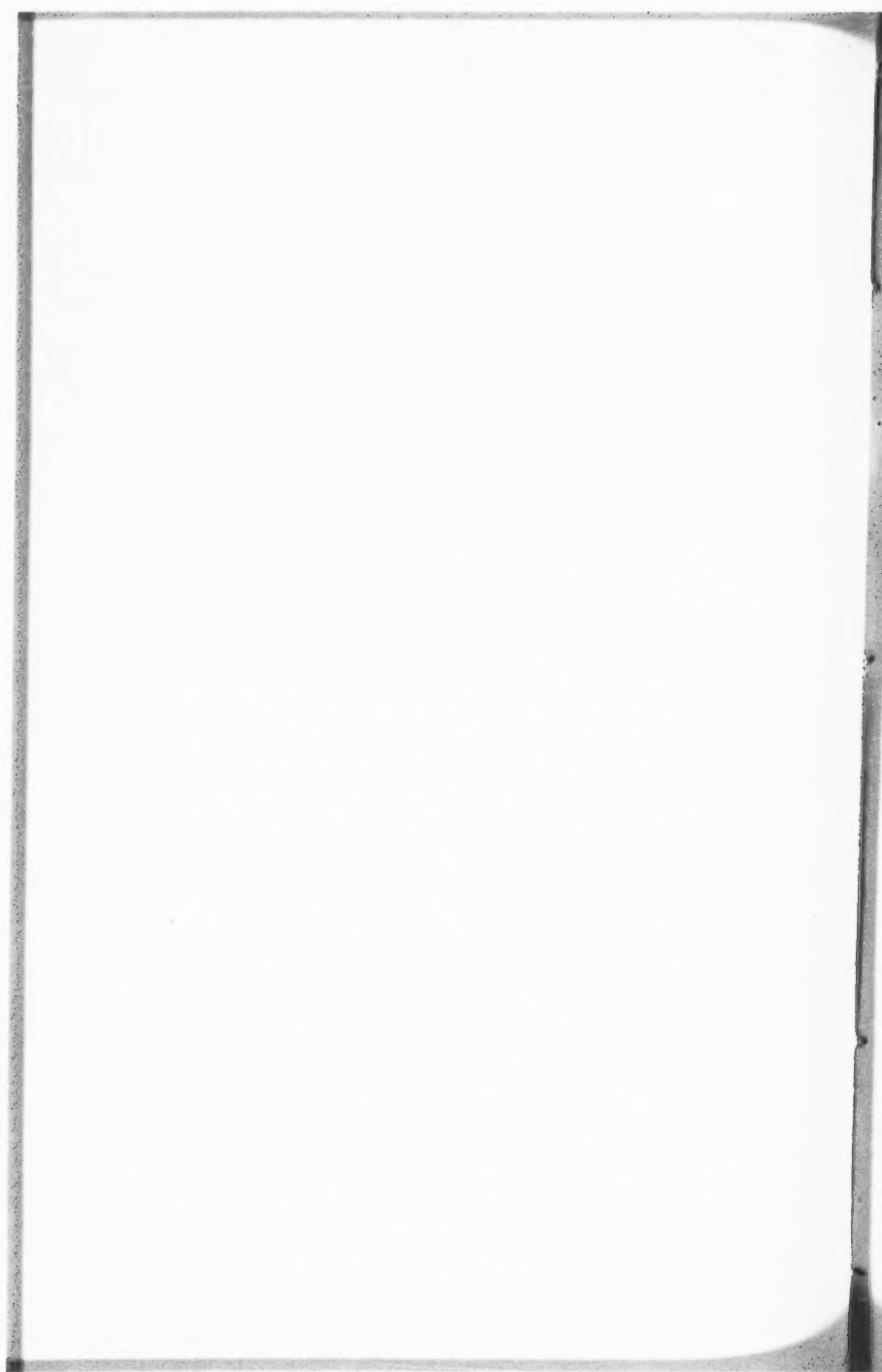
(Opposite Page 10)

Alleged to represent the full application position but which in fact truly represents the graduated position.



E.—The only difference between the two cuts is that port 40 is partially open in the upper cut and fully open in the lower cut.

The Valve 22 is *erroneously* colored Red, in order to have the coloring correspond with Plaintiff's cuts, and for the same reason the Graduating Valve is colored Black.



cuts, because if the relative parts had been shown complete, this *discrepancy in the traverses of the piston* would be at once apparent. The court will see the illogical and ridiculous outcome of an argument based on the invention by counsel of imaginary positions shown by cuts not in the record, and which have not been subjected to rebuttal evidence.

Now the plaintiffs' counsel resort in this specious graphic argument about "graduated" and "full" application with the small port 40 in order to reserve the old main-valve 22 of defendants' structure to be classed as the new auxiliary valve of patent in suit.

In this proceeding counsel fails to point out in defendants' structure the valve equivalent to the graduating valve (yellow) of the old patent 220,556 and also in patent in suit, and make the defendants' graduating valve 40 (which they erroneously call the "main-valve") take the place of *both* the graduating-valve (yellow) 29 and the main-valve (black) 14, of patent in suit. This is a startling proposition and is the handiwork of counsel, as the abridged cuts and the imaginary positions are not part of the record.

Plaintiffs' Counsel's Imaginary Air Action.

The phenomenal air action shown in cut opposite following page, reproduced from plaintiff's supplemental brief, page 11, which their counsel allege "*shows an additional operation*" of the train-pipe and reservoir airs (blue and red lines, respectively), in defendants' device, is wholly misleading. This graphically-displayed piece of fiction is even more startling than their previous one on account of the physical impossibility of accomplishing it, although plaintiff's counsel have the boldness to allege that it shows the action of the two airs (blue and red) in defendants' device.

The action that *actually* takes places by the train-pipe air (blue) and auxiliary-reservoir air (red) in defendants' device in a quick-action application of the brakes, is shown in the lower

cut opposite page 69 of this brief, where the two airs enter the triple-valve chamber and there commingle, becoming one air, and as impossible to *separate thereafter* as it would be to separate hot and cold water after they had been united. How, then, is it possible for the *two* airs to separate in the valve-chamber, as illustrated in the cut opposite, and portions of the auxiliary-reservoir air (shown by a red line) seek out the small graduating passage in the valve-stem and pass through it, while the train-pipe air (shown by a blue line) passes through the large port opened by the main valve 22?

To suggest such an absurd, preposterous physical action as this can only be the resort of persons in dire extremity.

This illustration is wholly misleading, and is used in order to *try* to show that in defendants' device, when a quick application takes place, two valves are employed (which is not true), one to vent the auxiliary-reservoir air (red line) and the other train-pipe air (blue line) with the object of making it appear like complainants' device where two valves *are used* in a quick application, viz: the main valve 14 of the triple-valve to vent auxiliary-reservoir air, and the "auxiliary-valve" 41, separate and "*independent*" from the main valve, to vent train-pipe air. The illustration is spurious and purely imaginary. No such operation of *two* valves is found in defendants' device, for the fact is the main-valve 22 (*one valve alone*) admits both airs, or rather the two airs, after they have been united in the valve-chamber which precludes any such ridiculous alleged operation of the two airs as suggested in plaintiffs' illustration.

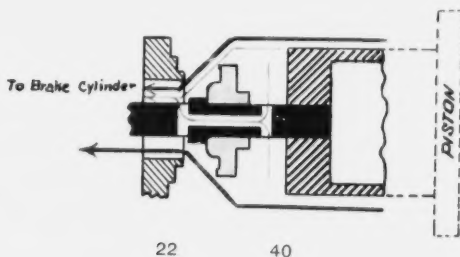
Plaintiffs' Counsel's Imaginary Partition.

Plaintiffs' counsel, realizing the importance of defendants' position in regard to Mr. Boyden's invention of *partitioning* the valve-chamber, by which the old triple-valve is made capable of venting the two airs in quick applications of the brake, have endeavored, by the illustrations opposite page 12 of their supplemental brief (illustrations that are not in evidence), to show

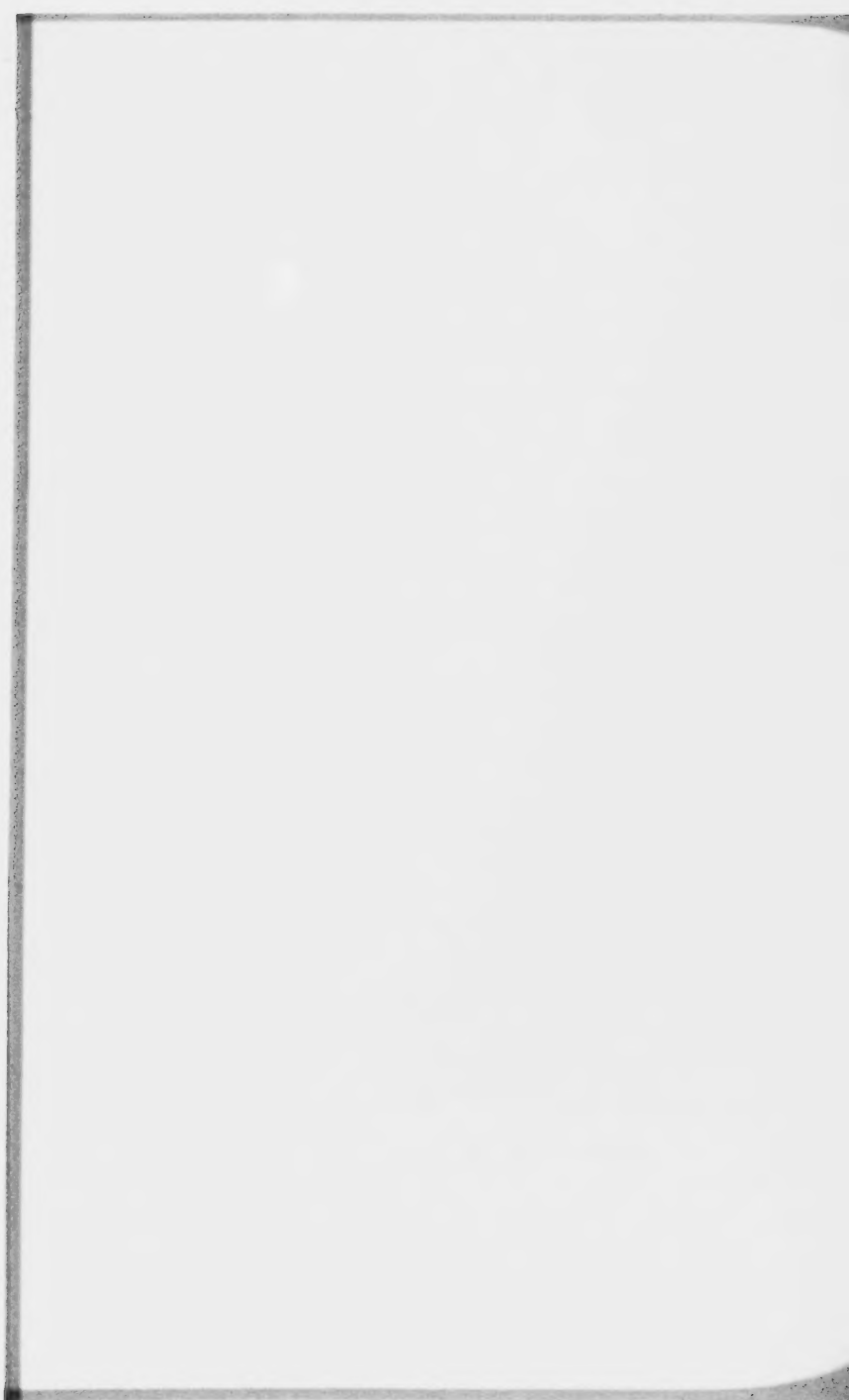
Cut from Plaintiff's Supplemental Brief.

(Opposite Page 11)

Alleged to represent a new operation in the Boyden structure, but which is wholly impossible because the Train Pipe Air (blue line) and Reservoir Air (red line) unite in the Valve Chamber and can never separate thereafter and consequently could not take the diverging and separate courses shown.



NOTE.—The Valve 22 is *erroneously* colored Red, in order to have the coloring correspond with Plaintiff's cut, and for the same reason the Graduating Valve is colored Black.



that plaintiffs' device contains a partition equivalent to Boyden's in order to make it appear that if *such* partition was removed quick action in the plaintiffs' *device* would be destroyed.

This *alleged* "equivalent partition" is marked X in the lower cut of said illustrations. Now, a partition, of course, does exist in plaintiffs' device, as partitions of *some* character must necessarily exist in *all* triple-valve devices, which, if broken or removed, would obviously destroy the quick-action application. But what conceivable bearing can *such* a partition have in the case at bar? The fact that the removal of a portion of the *wall* would destroy quick action, does not prove that *it* is the "equivalent" of Boyden's partition.

The removal of the passage 46 would also destroy quick-action and counsel might, therefore, call *it* the "equivalent" of Boyden's partition, but it would not be true. However, the *wall* marked X does not functionate to make the *old triple-valve* capable of venting train-pipe air in plaintiffs' device, as the defendant's partition 9 does in their device, and therefore the part X is *not* the "equivalent" of the defendants' partition 9. If such were the case, and *that* is Mr. Westinghouse's invention, we ask why did he *add* to the old triple-valve the "auxiliary-valve" 41 and the direct passage 46, which in the patent are designated as "additional members?" And why did he fail to describe such a partition in his patent, if thereby he could dispense with his *additional* members? This cut opposite page 12 of plaintiffs' supplemental brief is another piece of fiction, and the contention of plaintiffs' counsel is treating a very serious subject as though it were a farce, is wholly unwarranted from anything found in the Record, and is totally lacking in the dignity and frankness due to a cause before this Court.

Non-Identity.

The learned and ingenious counsel for plaintiffs, realizing that before claim 2, or any other claim of the patent in suit, can be adjudged to be infringed, *identity* must first be established between the two structures, and knowing truly that to produce

quick-action, plaintiffs' device requires the use of two valves at the final traverse of the piston, viz: the main-valve (black) of the triple-valve to vent auxiliary-reservoir air, and an "*auxiliary-valve*" (red) *added to the triple-valve to vent train-pipe air*; and knowing also that in defendants' device only *one* valve, in fact, is used to vent both the airs, *they must*, in order to establish identity show that defendants' device also employs an "auxiliary valve." Being unsuccessful in this matter in the lower courts, plaintiffs' counsel now proceed to introduce some newly-discovered evidence—some inventions of their own—and produce the erroneous illustrated propositions, the rationale of which would, if advanced before expert engineers, be received with ridicule.

The identity or non-identity being the controlling factor as to the determination of the question of infringement, and the plaintiffs depending on establishing identity by proving the main-valve 22 of defendants' device to be the "auxiliary-valve" of plaintiffs' patent, we desire, before closing, to call the Court's attention to the following fact:

The *main-valve* in all triple-valves is the valve which controls the *main-port* from the auxiliary-reservoir to the brake-cylinder, and is always opened by the "further-traverse" of the piston to admit the full and quick flow of air in applying the brakes for an emergency; and the sensitive "graduating-valve" is a valve *supplementary* to the main-valve, and used to admit air partially and slowly in graduating or making "service stops." The nomenclature was given by Mr. Westinghouse himself, and will be found in claim 1 of his patent 220,556, dated Oct. 14th, 1879, (R. p. 766), where the slide-valve is termed the "main-valve," and the sensitive graduating valve as "an auxiliary-valve operated by the same stem *to close or open a port through the main-valve without necessarily moving the main-valve.*" Boyden's stem, i, j, k, (some-

times marked 40), closes or opens "a port through the main-valve without necessarily moving the main-valve," and therefore corresponds *exactly* to the sensitive graduating valve *e*¹ of Westinghouse's patent 220,556 (marked 29 in the patent in suit), and does not correspond in any respect to the main-valve of either patents. Judge MORRIS and the Circuit Court of Appeals were clearly right, therefore, in holding Boyden's stem-valve, i, j, k, to be the graduating valve, and his poppet-valve 22, the main-valve, of his device; and this fact and the finding by the Court that it is a fact is, we submit, decisive of the whole controversy.

Complainants Have Shifted their Position on the Main Issue.

We desire to call the attention of the Court to the very remarkable and, we submit, very unjust position now assumed before this Court by plaintiffs' counsel.

The patent in suit defines the invention as consisting of the old triple-valve, *provided* with *certain* "additional members" to perform the new function (R., p. 786, L. 5), and describes the "additional members" as an "auxiliary valve 41" and a passage 46 leading from the train-pipe to the brake-cylinder (R., p. 786, L. 8).

The plaintiffs' expert (Newbury), explaining his understanding of the combination of devices in claims 1, 2 and 4, alleged to be infringed, and particularly claim 2, which is considered by plaintiffs to "more nearly cover the invention," states (R., p. 28, L. 17):

"This claim 2, when read in the light of the specification, is for a combination of four essential elements or

"devices combined together to form a brake mechanism," as follows:

- a. A main-air or train-pipe.
- b. A reservoir to be attached to a car.
- c. A brake-cylinder provided with a piston which connects with the brake-shoes of the wheels of the car.
- d. A triple-valve provided with a piston and "*a valve mechanism*," the piston having two traverses * * * the preliminary traverse operating the (triple) valve mechanism for the admission of air from the auxiliary-reservoir to the brake-cylinder, * * * and the further traverse operating the "*valve mechanism*" * * * for the direct admission of air from the train-pipe to the cylinder.

It will be observed in the above that the *auxiliary-valve element* of the combination is termed by the expert "a valve mechanism."

The same expert witness finds that claims 1 and 4 describes substantially the same as above, but instead of designating the new element "a valve mechanism" he says in these claims it is an "auxiliary-valve." This witness then alleges that he finds these combinations in the defendants' device by selecting the valve 22 thereof as the "auxiliary-valve," or "a valve mechanism," as he terms it in claim 2.

Thus the plaintiffs rested their *prima facie* case.

The defendants accordingly answered this position of plaintiffs by showing that their structure does not employ "a valve mechanism" or an "auxiliary-valve" in combination with the triple-valve, and that the valve 22 is not an added or auxiliary-valve, but is the *old original main valve* of the triple-valve, endowed with a greater capability, by which train-pipe air may be vented at the same time it (the main valve) opens to vent auxiliary-reservoir air, thereby simultaneously venting both airs through the main valve, without using an auxiliary-valve and

separate passage, the "additional members" of the patent in suit, or their mechanical equivalent in any form.

The case was thus made up, and the position taken by the plaintiffs was defended on *these lines*, and in due course came before the Court for argument.

The plaintiffs in their briefs, pp. 40-41, used in the two courts below, when summing up the position they had taken as to claims 1, 2 and 4, stated:

"Thus it will be seen that this *quick-action* attachment, consisting of an air conduit or passageway directly from the *train-pipe connection* to the brake-cylinder, and a valve to control it, such valve being itself under control of the triple-piston and so combined with the old automatic brake appliances * * * that *this*, the chief novelty and element of utility of the Westinghouse invention now in controversy, is so made the *subject-matter of EVERY claim in controversy* as to give character and effect thereto, and render the scope of the claims co-extensive with the invention."

On *the issue* thus made up and tried in the Circuit Court, Judge Morris said:

"I have not been able to satisfy myself that Boyden 'makes use of an 'auxiliary-valve' in the sense in which that term is employed in the specification and in some of the claims of the patent No. 360,070 now in suit.' (Rec., p. 841). 'And what Westinghouse meant by the 'auxiliary-valve' * * * is such a valve as he described in his specification, and which is independent of and performs none of the functions of the main-valve of the ordinary triple-valves.' Also 'the defendants' valve 22 must be considered to be the main-valve.' (R., p. 845, l. 2.)

The Circuit Court of Appeals for the Fourth Circuit affirmed Judge Morris, and said: (R., p. 881)

"Boyden's (22) is not an 'auxiliary-valve': it is mechanically the original main-valve of the original triple-valve, and it performs the service which is performed

“by the main-valve of 220,556. It is not the mechanical equivalent of valve four (auxiliary-valve) in the attached apparatus of Westinghouse, simply by reason of its taking part in an emergency service in admitting train-pipe air into the brake-cylinder. In the original triple-valve it (the main-valve) performed no other service than admitting auxiliary-reservoir air into the brake-cylinder; *in Boyden's device it continues to perform that service*, and is made incidentally instrumental in allowing the passage of train-pipe air. The performance incidentally of quick-action service does not make it ‘an auxiliary-valve.’ It is the same valve. The incidental *service* is auxiliary, but the valve itself is the same and unchanged. We think the Circuit Court was correct in its view that the poppet-valve 22 of Boyden is the original main-valve of 220,556.”

Now after judgement in favor of defendants; after these findings of fact; after failing to convince the two Courts below that defendants use “an auxiliary-valve” or “a valve-mechanism” combined with the old triple-valve, complainants come into this Court and shift their position, and take a *new* one, one wholly inconsistent with their *prima facie* case against which the defendants’ defended, which new position is as follows:

The counsel for plaintiffs now define in their brief before this Court, p. 80, the plaintiffs’ invention and patent by saying it consists of—

“Certain features of the structure, which confer upon it its new capacity, viz: (1) the *double* traverse of the piston, (2) a passage or way of access, directly from train-pipe to brake-cylinder, and (3) a valve which *controls* that passage.”

“These features are the essential features of the ‘means’ by which the triple-valve piston, in its ‘further traverse,’ acts to perform its function of admitting air directly from the train-pipe to the brake-cylinder.”

On this important point (essentials) the patent specification is clear and explicit and shows that what complainants' counsel call the "*essential features*" to wit, the passage for train-pipe air, and a valve which controls that passage, are expressly stated to be "*additional members*" to the triple-valve, consisting of an auxiliary-valve 41 and passage 46. (Rec., p. 786, L. 5.)

Again in Westinghouse supplemental brief, more recently filed, on page 27, counsel take the new ground that claim 2 should be read by twice inserting the words "*by opening a port.*" By this they mean the Court to understand that claim 2 has no limitation whatever beyond that expressed literally by its words, except what they indicate by the proposed insertion of the words "*by opening a port,*" in other words, the new position taken by counsel in this court is, that they now regard claim 2 to be broader than they thought it to be at the outset of this litigation. Then, they said of the "auxiliary-valve device:"

"That *this*, the chief novelty and element of utility of
 "the Westinghouse invention now in controversy, is so
 "made the subject-matter of *every claim in controversy*
 "as to give character and effect thereto."

But such is not their view now, they have seen reason in the adverse decisions of the two lower courts to shift their position, and they do not hesitate to do it.

We submit that the position now assumed by plaintiffs' counsel is specious and untenable and should be scanned with caution by the Court. Complainants having been defeated in the lower courts on the position first taken are now resorting to one of the tricks of the sophist, to wit., first, manufacture or assume a *new definition* of terms better suited to their purpose, and second, endeavor to have the facts marshalled and judged according to their new and spurious definitions.

No 99 and 116.

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Supreme Court of the United States.

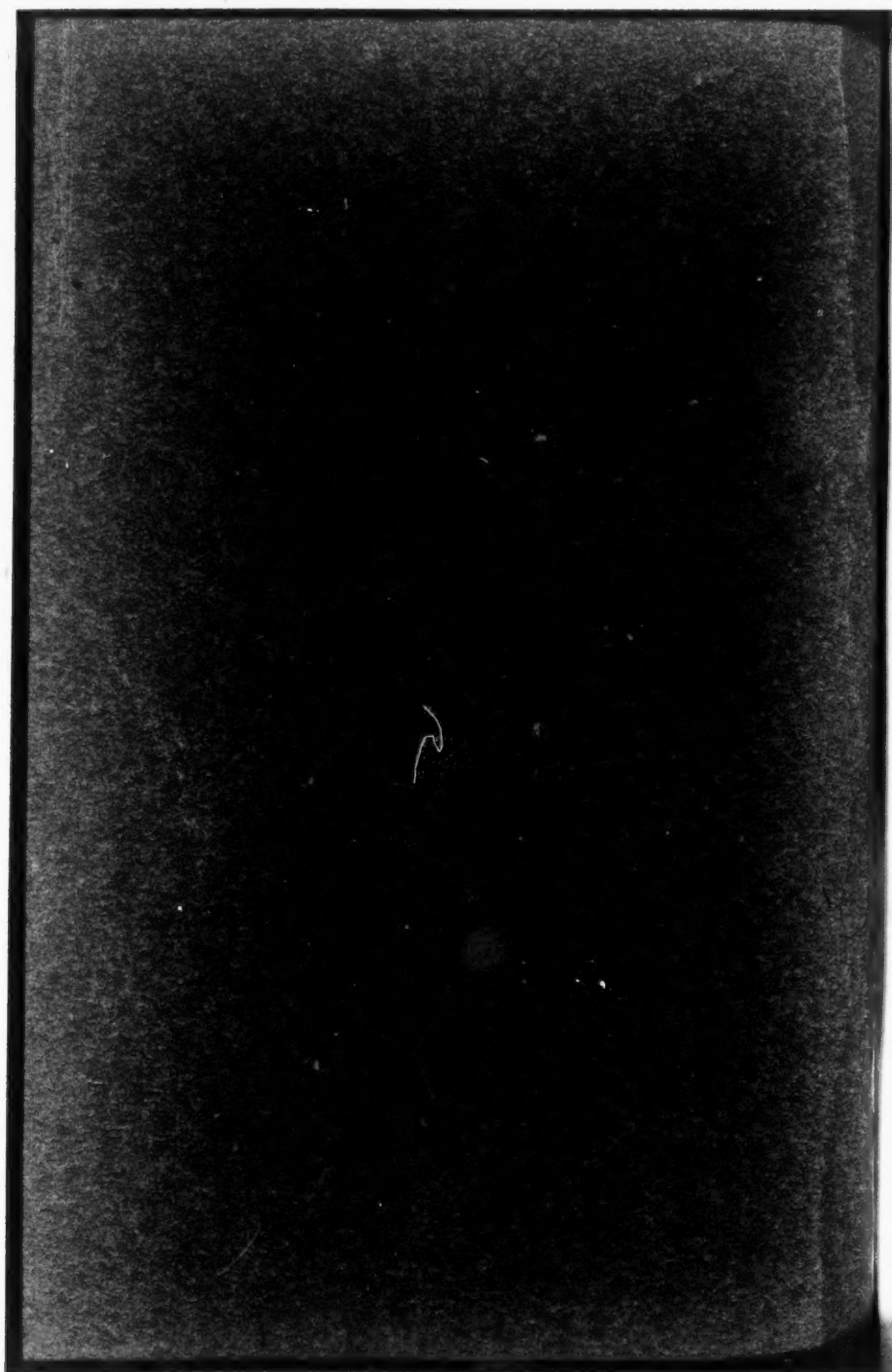
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THE SENT

Of Counsel for Defendants



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Supreme Court of the United States.

Westinghouse vs. Boyden==Air-Brake Case

BRIEF FOR DEFENDANTS ON THIRD ARGUMENT.

INTRODUCTORY.

The issue in this case is infringement of patent No. 360,070, granted to George Westinghouse, Jr. The dispute is almost entirely with respect to the lawful scope of this patent, and particularly of claim 2 thereof. Although there are minor disputes, as for example with respect to the philosophy or theory of operation of Defendants' brake, the decision of these would not effect the main dispute, to which we shall here chiefly direct our attention.

We propose, however, to include in this brief an explanation of, or reference to, all matters which are necessary to an understanding of the case. Our reasons for so doing are, first, that one member of the Court was not present at the previous arguments, and second, that we desire to save the Court the labor of examining numerous briefs in order to ascertain our position on the material points in controversy. This is our apology for repeating here explanations of many points that are already well understood by a majority of the Court.

The demand of the Court for a third argument of the case indicates that the main issue has proved difficult and perplexing to the Court, and admonishes counsel to scrutinize and be sure of their premises and of the deductions made therefrom.

The attention of counsel has been specially directed by the Court to the question whether the patent sued on "could be sustained as to process or method;" and the specified elements by which this inquiry

is to be determined are "the state of the art, including the patents of Westinghouse," "the proceedings in the Patent Office," and "the terms of the patent itself."

Although claim 2 of the patent sued on is a claim in terms for a combination of elements constituting an automatic air-brake, and not a claim for a process or method, and although no claim is made in the patent for a process or method, nor is any process or method described in the specification, one contention of Complainants is that this claim should be so construed as to cover the operation of admitting air directly from the train-pipe to the brake-cylinder, whenever that is done *for the purpose* of securing a "quick action" of the brakes.* A claim for a new "process or method" is therefore advanced in the argument, though not made in the patent; or, in other words, Complainants contend for such a construction of claim 2 as, if it be adopted by the Court, would be tantamount to sustaining the claim as to the process or method.

Analysis of this contention discloses that it is based primarily upon the proposition that the invention of the patent sued on is of "primary" character, and that the patent is a "pioneer" patent. The position taken by Complainants' counsel appears to betray recognition of the fact that, if the patent be construed, according to the *ordinary* rule, applicable to *ordinary* patents, (as covering the novel means it discloses and the substantial equivalents thereof) Defendants cannot be held as infringers, and that, therefore, it will be necessary to obtain the aid, in construing the patent, of an *extraordinary* rule, applicable only to *extraordinary* patents, to wit, to so-called "pioneer" patents.

In examining this contention, therefore, we are called upon to answer the following questions:

1. What is a pioneer patent?
2. Is the patent sued on a pioneer patent?

The question of infringement, and the specific question proposed by the Court, may be answered without determining the question of "pioneership;" but this latter question is made a prominent issue by Complainant, and since presumably the Court will pass upon it, it comes within the scope of our discussion.

*It is not contended by Complainants that the patent in suit is the first to disclose this operation, which is admittedly old, but the first to propose it *for a particular purpose*.

The determination of the question of pioneership will depend upon certain material matters of fact. These important or determinative facts are few in number, but it is of the utmost necessity to ascertain these with accuracy, and to apprehend fully their import, for otherwise no step in the deduction which we are called upon to make can be taken with confidence and certainty.

Careful analysis is here required to determine, not only what matters of fact are legitimate premises for the deduction to be made, *but also to distinguish these from facts which are not material to the main issue and cannot be legitimately used as premises in the discussion.* These immaterial facts and illegitimate premises should be rigorously excluded from consideration, and this should be the law of the discussion *for both sides.* We insist, at the outset, upon the importance of this analysis, and of discrimination between material and immaterial matters, because we believe that the main contention of Complainants with respect to the construction and scope of the patent in suit is based upon an illegitimate premise, to wit, upon the achievements claimed for Mr. George Westinghouse, Jr., in the development of the air-brake as the result of inventions made and patented *before* and *after* the particular invention of the patent in suit. What the Court demands to know in this connection is the exact dimensions of the new, practical result attained by the novel means disclosed by the patent in suit. The results of other inventions, whether earlier or later, are material solely for the purpose of *excluding them* from the scope of the patent in suit, and thus arriving with greater certainty at the exact extent of the result accomplished by and due to the specific invention of that patent.

We shall further require in our discussion precise definitions of certain terms of frequent occurrence in this case, so that *whenever such expression is used* it may convey *the same meaning*, and always *that specialized meaning given to it* in this case.

With a firm grasp on these essential things we may enter upon the discussion of the issue with a reasonable expectation of arriving at a sound conclusion with respect thereto.

DEFINITIONS.

The term "Quick-Action Brake" is used in this case with a specialized meaning. What is that meaning?

There is no natural line of demarkation by which brakes can be classified as either "quick-action" or "non-quick-action." In the development of the air-brake during the past thirty years one aim of inventors has been to quicken the action of the brakes as far as practicable. Every time an improvement in this respect has been effected the result has been a brake which had "quick-action" with reference to what preceded it.

Furthermore, the term "quick-action" may have reference to the operation of each *individual* brake, referring to the interval of time between the act which initiates the operation of the individual brake and the full application thereof. Or it may have reference to the operation of a *connected series* of brakes on the several cars of a train, referring to the interval between the act which initiates the operation of the series of brakes and the full application of the *last* of the series. The distinction here to be observed is that between quick action in the *individual* application of the brake on the one hand, and quick action in the *serial* application of the brakes on the other hand.

Prior to the invention of the patent in suit a maximum in quick-action for individual application of air-brakes had been attained. Abrupt application of the brakes with full pressure is not desired in ordinary or "service" stops, and even for "emergency" stops an application of the brakes as abrupt as is desired or needed was obtained from the auxiliary reservoir, the quickness of action being a mere matter of the maximum size of the valve-opening between that reservoir and the brake-cylinder. In modern practice, the brakes are never abruptly applied, in making emergency stops, with the full power available in the auxiliary reservoir, and which was available in the brakes of the prior art. On the contrary, provision is made to *prevent* the abrupt application of this power to the brakes.

But beyond this the brake-mechanism of the prior art was capable of "quick-action" in the *serial* application of the brakes to the full extent necessary for all trains which were equipped with continuous air-brakes up to that time, or for which such equipment was desired by the railroad interests. Until a short time before the patent

sued on no demand had been made by those interests for air-brake equipment, except for passenger trains, which rarely comprise more than ten cars, and usually a much smaller number. For such trains the old brake-mechanism possessed fully the essential of quick-action in serial application, that essential being that *all* the brakes of the train should be "applied or brought into action simultaneously,"* or practically so.

In 1886 the Master Car Builders' Association made a demand upon the manufacturers of brakes for an air-brake which could be successfully used on freight trains comprising as many as fifty cars, and which when used on trains of that length would be effective for making both "service" stops and "emergency" stops, just as was accomplished by existing brake-mechanisms on short trains. That association determined and stated the requirements which such a brake mechanism should fulfil, among these being that "it shall work without shock on a train of fifty cars" (Rec. p. 133). This requires "practically simultaneous" action of the brakes, or to substitute a definite formula for the indefinite statement "practically simultaneous" it requires full application of the last brake on a train of fifty cars within three and one-half seconds from the operation of the engineer's controlling-cock.† No brake which does not accomplish that is a "quick-action brake," as that term is employed in the art and in this case.

Therefore, when we say that the devices of Complainants and of Defendants are "quick-action brakes," we mean that they are brakes which, when employed on a train of fifty cars, will so operate as that the last brake will be fully applied within three and one-half seconds from the opening of the engineer's controlling-valve. The term, as

* Westinghouse patent, No. 217,838, July 22, 1879, p. 760.

† This formula is given in the proceedings of the Master Car Builders' Association of 1895, (p. 245) in the following words: "No. 2. Application Test (b) (Emergency).—Brakes must be applied on the fiftieth car with at least 45 pounds pressure, with 6 inches piston travel, in three seconds from the first movement of the engineer's handle. They should indicate at least 55 pounds in three and one-half (3½) seconds."

Judge Townsend (59 F. R. 585.) defined the "quick-action element" of the modern brakes as being "such an arrangement of the triple-valve on each car as to make the opening of such vents, and the consequent reduction of train pressure *practically simultaneous on each car.*"

applied to the modern brake, has no distinctive reference to the *individual* application of the brakes, but only to the *serial* application thereof, and to the latter only when the series embraces a very large number, as fifty.

Finally, it is to be noted that "quick-action air-brakes," even in the restricted meaning here given to the phrase, had been produced and operated with entire success prior to the invention of the patent in suit. In the successful "quick-action brakes" the opening of the discharge valves for "emergency" stops was effected by the agency of electricity. Hence a further restriction to the meaning of the phrase is necessary, and we must confine it in this discussion to *quick-action* brakes wherein the defined requisite promptness of serial application is effected by the agency of compressed air alone.

When Complainants' counsel say that Westinghouse was the first to invent and produce a "quick-action brake," they mean a brake which fulfills the requirement specified above, when operated by compressed air alone. Any brake which will do that practically is a "quick-action brake" within the meaning that attaches to that term in the art, and in this case. If the brake of the patent in suit accomplished that it is a "quick-action brake;" if not, it is not a "quick-action brake."

Another term for which at least a proximate definition is much needed is "pioneer invention," and, in defining this, we have also to notice the meaning of the phrase "new result" when used in this connection.

The terms "pioneer" and "primary" are used to designate inventions of peculiar importance, and the mark by which an invention of that character is distinguished from other inventions is the accomplishment thereby of an *industrial* or *practical* result, beneficial to mankind, and which had never before been accomplished. Judge Townsend defined a pioneer invention as one which "*for the first time* enabled 'a law of science, or force of nature, to be used so as to accomplish a *practical* and *beneficial* result'" (59 F. R. 592). Every invention, to be patentable, must produce a "new result," that is, it must present some advantage in efficiency or economy over known devices of the same class, or be characterized by some new and meritorious feature of construction or operation. This merely says that an invention, to

be patentable, must be "useful." But the "new result," in order to place the means which attained it in the rank of "pioneer" or "primary" inventions, must be broadly a new *industrial* result. An invention which merely introduced into an old structure a novel feature of operation with an incidental gain in economy or efficiency, without producing a radically new practical result, would not be a "pioneer" invention.*

Bringing together, then, our two definitions to determine what is meant in this case by the expression "the pioneer quick-action air-brake," we find that that expression applies to, and only to, the brake-mechanism, which, *for the first time in the history of the world, accomplished the full serial application of all the brakes on a train of fifty cars within three and one-half seconds by the agency of compressed air alone.*

If the brake mechanism of the patent in suit did this, it is the "pioneer quick-action air-brake," otherwise it is not. We here concede, *argumenti gratia*, that the first employment of a particular agency (air) to perform a particular office (opening the discharge-valves) which had previously been performed by another agency (electricity) to produce an old result ("quick-action" braking), may be properly dignified by the title "pioneer" invention.

It is only by expanding to this extent the term "pioneer" that Complainants can be allowed, without challenge, to say that Westinghouse was the pioneer inventor of the "quick-action air-brake." Allowing this latitude of meaning, the pertinent question is, was this "pioneer quick-action air-brake," or were the means by which "quick-action" was for the first time accomplished, patented *in and by the patent in suit*? Consulting the briefs of Complainants' counsel for their position on this question, we find that, while they assert with great earnestness that Westinghouse *was* the first to produce the new industrial results of "quick-action" (as above defined) by the use of compressed air alone, they base this assertion on the sum of the results of several inventions patented to Westinghouse, some before, and one (a very

* For example, in the leading case, *Morley Mach. Co. v. Lancaster* (129 U. S. 273) the patent was held to be a "pioneer," because the Court found that Morley was "the first inventor of an automatic button sewing machine." In *McCormick Mach. Co. v. Aultman* (C. C. A. 69, F. R. 371) the inventor was held to be a pioneer, because the invention of the "Gorham patent was the first which successfully bound grain with twine in the field."

important one) *after* the patent in suit. When we look in their brief and arguments for the definite description of that new industrial result which *the invention of the patent sued on* accomplished for the first time in the history of the world, and which, therefore, identifies *it* as a "pioneer" invention, we find that they are not able to attribute to it *any* new industrial result. They here substitute for a new *result* what is merely an *operation* (not in itself *new*), and which might not, and, in fact, *did not*, accomplish the specified *result*. They say on this point—

"*This discharge of the TRAIN-PIPE into the brake-cylinder to produce QUICK-ACTION was absolutely new with him.*" (Westinghouse).*

The italics and capitals in the quotation are those of Complainants' counsel (main brief, p. 17).

Manifestly this assertion—the extreme statement which Complainants' counsel feel justified in making in respect of the result attained *by the patent in suit*—is merely a statement of a *particular place of discharge of the train-pipe*, qualified by a reference to the *object* which the inventor *designed* to produce by discharging the train-pipe into that particular place, and which, without that qualification, would not be a true statement. The force of even this qualified statement is much diminished, if not completely neutralized, by having in view the facts for which counsel were endeavoring to make proper allowance in this extremely guarded statement. These facts are briefly—

1. That the discharge of the train-pipe at the *same points*, by the *same means* (reduction of train-pipe pressure opening valves at suitable intervals along the train-pipe) and for the *same purpose* ("to produce quick-action") was old.†

*The contention of Complainants, to which we shall largely devote attention, is that stated in their main brief filed at the first argument, and which is built upon the proposition that Westinghouse was the "pioneer" inventor of the "quick-action" brake. This proposition necessarily assumes that the *patent in suit* is the patent for that pioneer invention. Complainants' counsel do not assert this, but by dextrous use of language seek to establish it by inference without putting it in issue by direct assertion. We do not know what ground Complainants' counsel will take on this third argument, for they have not always been consistent, and have, on at least one previous occasion, retreated from the contention of pioneership and stood on the proposition that Westinghouse, by the patent in suit, accomplished (not "quick-action") but a more powerful *individual* application of the brakes; that he did this by the further traverse of the piston (which had never been used before for that purpose), and that Defendants accomplished the same result by the same means, and hence infringe claim 2. This view of the case will be fully considered herein.

† Westinghouse patent No. 217,838 (p. 759)

2. That the discharge of the train-pipe "into the brake-cylinder" with the results that necessarily attend that operation *per se* (though not to produce "quick-action") was old.*

3. That, while the *object* sought by "this discharge of the train-pipe into the brake-cylinder" might have been "to produce quick-action" it failed of its object, and that the *result* achieved thereby in respect of quickening the action of successive brakes, was precisely that attained when the discharge of the train-pipe was to the atmosphere, as in the prior art.†

In making the foregoing needed definitions we have brought into view some of the material facts and matters by which the issue must be determined, and particularly have we done so in noting the facts which hampered Complainants' counsel in their attempt to describe a "new result" as accomplished by the patent in suit. What is now of immediate importance is to establish firmly that we have stated those facts fairly and accurately. This brings us to a determination of *the departures presented by the patent sued on from structures of the same class existing previously in the art, and of the practical results of those departures.*

This is to be determined by comparing the structure, operation and result of the patent in suit, with the structures, operations and results of the prior art, including the previous inventions of Westinghouse himself.

It is particularly to be noted that these previous inventions of this patentee can be referred to in the present case *solely for the purpose of limiting and defining the scope of the patent sued on.* (James v. Campbell, 104 U. S., 356.) The merit due to them can be considered in this discussion only to *diminish* the merit to be ascribed to the invention of the patent in suit, and cannot by any possibility be considered to *magnify* the importance of that specific invention.

In all the briefs and arguments that have been presented, here and in the Courts below, the great credit said to be due to Mr. Westinghouse for the development of the air-brake has been urged as a fact which ought to influence the judicial mind to place a broad interpretation upon the particular patent sued on. On the other hand, we contend that the merits of this patentee, as an inventor, so far as they

* Boyden patent, 1883, No. 280,285 (p. 776)

† Dep'n H. H. Westinghouse, p. 124, fol. 185.

have the slightest bearing upon any question before this Court, are precisely such as they would be if this were the only improvement he had ever made, and this the only patent that had ever been granted to him. *For the purpose of adjudicating the issues of this cause justice must be blind to every achievement of this patentee, save that only which was accomplished by the invention of this patent. Other inventions of the same patentee, earlier and later, have the same bearing as if they were the inventions of strangers.*

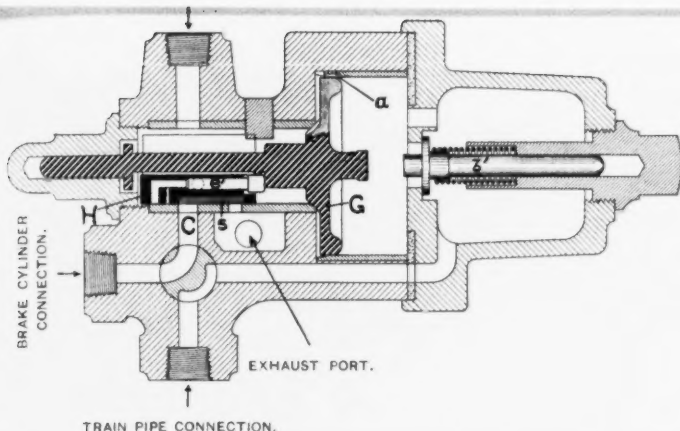
THE NOVELTY IN CONSTRUCTION AND OPERATION OF THE MECHANISM OF THE PATENT IN SUIT.

The patent sued on, No. 360,070, we shall, for the sake of clearness and to avoid the obscurity due to the use of meaningless numbers, designate hereafter as the "auxiliary-valve patent in suit," designating other patents to which frequent reference is made by appropriate titles which suggest the inventions covered by them.

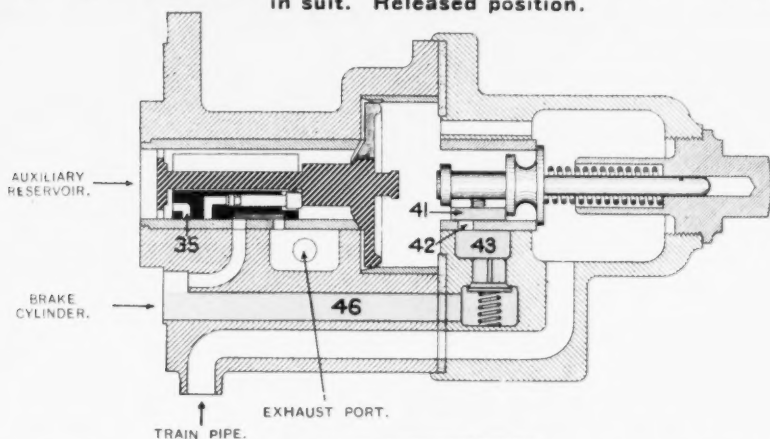
There is no difficulty at all in determining accurately what new thing or things the patentee did in and by the structure of the patent in suit. The difficulty is not met, and the dispute does not arise until the attempt is made to base upon those new features a construction of the patent which will both stand the test of comparison with the prior art, and at the same time clearly embrace Defendants' brake.

What Westinghouse did by this invention was to add to the old triple-valve structures (such as No. 220,556, of 1879, which we will call the "old automatic triple-valve patent") certain "additional members" (as the patent states), these members being a by-passage from the train-pipe to the brake-cylinder, short circuiting—so to speak—the triple-valve chamber, and an auxiliary-valve controlling it and normally cutting off the communication between it and the train-pipe; and he opened this "auxiliary"-valve by means of the usual spring-pressed stem with which the piston made contact, and which it displaced when making its usual "further" or complete traverse for the purpose of an "emergency" stop.

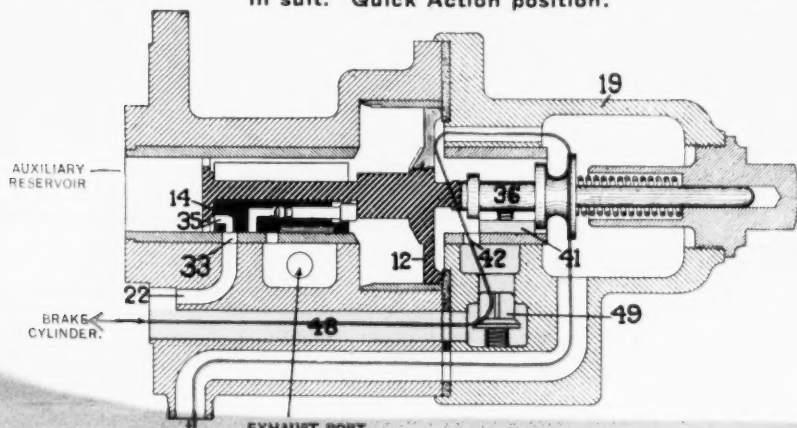
The diagram opposite this page illustrates the structure of the auxiliary-valve patent in suit. Ignoring the parts colored red (which represent the quick-action attachment) we have the old "triple-valve" mechanism of the old automatic triple-valve patent, No. 220,556.



Old Triple Valve device, plus the "Auxiliary Valve device" of the patent in suit. Released position.



Old Triple Valve device, plus the "Auxiliary Valve device" of the patent in suit. Quick Action position.



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The triple-valve takes its name from the presence of three valves in a common valve-chamber. These are, *first*, the "feed-in" valve *a*, colored blue, the "release"-valve *s*, colored green, and the "main-valve" *H*, colored black. These valves have a common actuating organ, to wit, the piston *G*, which, in turn, is moved by varying the air pressure in the train-pipe. The main-valve *H* controls the passage *C*, leading from the valve-chamber to the brake-cylinder. As usual in triple-valves of the prior art, the main-valve has a subordinate member, termed the "graduating"-valve (colored yellow in the cuts), whose function is, upon a slight reduction of train-pipe pressure and a correspondingly slight movement of the piston *G*, to uncover a relatively small part of passage *C*, and thus admit air from the auxiliary-reservoir to the brake-cylinder, applying the brakes gradually and with moderate pressure. Thus, while we find in the old automatic brake a *fourth* valve, if we regard this (as it is in fact) as but a subordinate member or part of the main-valve, the term "triple-valve" is not inappropriate.

When, on a greater reduction of pressure in the train-pipe, the piston is moved still further forward, making its "further traverse," it moves the main-valve so as to fully open the port *C*. This port *C* is larger than that controlled by the graduating (yellow) valve, thus admitting air more rapidly and abundantly, and thereby producing a quicker maximum application of the brakes. This further movement of the piston was always resorted to in emergencies, or whenever it was desired to stop the train quickly.

In this "further" or "emergency" traverse of the piston it made contact with the end of stem 36, and displaced the latter against the pressure of its spring. In the old brakes this stem performed no office except to check the piston at the end of its preliminary traverse.

By the patent in suit the parts colored red were added to this old structure. These added parts comprise a passage, 46, from the train pipe side of the piston to the brake-cylinder, and an "auxiliary"-valve, 41, normally closing said passage. This auxiliary-valve was mechanically connected with the stem, 36, so that this plunger performed the new office of actuating this valve, while the piston performed its old office of displacing stem, 36. It may be said that indirectly the piston performs a new office, in that it actuates stem, 36, and through it valve, 41. But in the same sense it may

with equal accuracy be said that, by reason of the addition of valve, 41, the engineer's-valve on the locomotive performs a new office, because it indirectly actuates valve 41.

The operation is such that when the engineer operates his valve, as before, and the pressure is reduced as before, and the piston makes its further traverse as before, and stem, 36, is displaced as before, valve 41 will be opened by said stem, and the air in the train-pipe will discharge into passage, 46, and thus quicken the action of the brake next in series.

Here then is the basis which Complainant's counsel have for stating that, in the brake of the auxiliary-valve patent in suit, the further traverse of the piston produces a new effect, or performs a new *operation*, to wit, discharging the train-pipe into the brake-cylinder.

What were really the *new* means which performed, in this structure, the indicated operation is a controverted matter and one which must be decided before the test for infringement can be applied.

In this structure and its operation we have also the basis (if any there be) for the contention that the patent can be sustained as to method or process; although before that question can be answered the extent of novelty in the structure and its operation must be determined by reference to the prior art.

If it be held that the patent can be sustained for this process or method, the further question remains, does the brake of the Defendants, when used to produce quick-action, employ this process; i. e., does it have a piston, which, by a further traverse, "admits air directly from the train-pipe to the brake-cylinder?"

THE PRACTICAL RESULTS ACCOMPLISHED BY THE INVENTION OF THE PATENT SUED ON.

No exception will be taken, we think, to the accuracy of the foregoing statement of the novel features of construction and operation in the patented brake. We will, therefore, not interrupt the thread of the argument at this point to make minute explanations of the new structure, or minute comparisons thereof with old structures.

We have now to ascertain the *practical result* of this invention with special reference to the advance made thereby in the direction of producing a "quick-action brake." On this point we will depend upon

the deposition of Mr. H. H. Westinghouse, general manager of the Westinghouse Air Brake Company. This matter must be determined for its bearing on the question of "pioneership," but the chief importance of the inquiry, in our minds, is to determine with certainty what is the *cause* of "quick-action," and what are the *agencies* through which that cause operates in Complainants' brake to produce that result. These *agencies*, if new, are the patentable "means."

The brake of the patent in suit was specially designed to remove the difficulty which prevented the old automatic triple-valve of patent No. 220,556, then in general use, from being employed on long trains—that difficulty was the lack of sufficiently close approach to *simultaneous application of all the brakes*. The interval between the application of successive brakes on a train of fifty cars produced violent shocks, due to the fact that the forward cars of the train were checked before the speed of the cars further from the locomotive was diminished. Stated with precision, it was found that on a train of fifty cars, equipped with the standard automatic brakes, it required *twelve seconds* to apply fully the brakes of the last car.

This slowness of serial application was due to the fact that the air discharged from the long train-pipe to operate the brakes had only a single discharge opening, which was located at the engineer's valve, and hence the effect of opening that valve was not felt at the last brake until an appreciable time after the first brake was fully set (p. 123).

These old automatic brakes, under the conditions specified, were fully tested at Burlington in 1886, and in the report of the Master Car Builders of June, 1887 (p. 118), the result was summed up by this statement:

"The result of these 1886 tests was disappointing. None of the competitors, in the estimation of your committee, did satisfactory work, *owing to the violent shocks produced in stopping.*"

In other respects the results appeared to be satisfactory, for while "the expected delays in discharging and releasing continuous brakes were shown to be of no moment, * * * the objection of *successive application* was developed to an extent calling for the most serious consideration."

The violence of the shocks or collisions was registered in these tests by an apparatus called a "slidometer." A movement of 12

inches of the slidometer was found to be injurious to live stock and equipment, while movements of from 12 to 20 inches were destructive (p. 119.) "With the train fitted with the Westinghouse 'automatic' brake the maximum shock was *forty-nine* inches on 'emergency' applications" (p. 120.)

The principal object then to be attained was to prevent those shocks by bringing about quicker "*successive* application" of the brakes, which was shown to be the one thing needful. The cause of this slowness was well known, and Mr. Westinghouse had many years previously perceived that practically simultaneous action of all the brakes could be brought about by providing the train-pipe with a number of doors or exits for the air (one under each car), by opening which the air could discharge, thus quickly relieving the pressure along the entire length of train-pipe. He also perceived that these doors could be made to open *by the reduction of pressure* in the train-pipe itself. All this he had disclosed, and the means for effecting it he had patented in 1879, patent No. 217,838, which we will hereafter call the 1879 "local-vent" patent.

In that patent he had *not* thought of operating these discharge valves through the intermediary of the triple-valve piston; but he provided, as the actuating motor for each discharge valve, a separate or supplementary piston.

The object of the invention of this 1879 local-vent patent (No. 217,838) is thus stated in the specification thereof.

"It sometimes happens with such brake apparatus, especially *in case of accident*, that material advantage could be effected by having *all the brakes of the train applied or brought into action simultaneously, or as nearly so as possible*. To accomplish this it is only necessary to make provision for the *simultaneous opening of one or more ports in the air conduit passages at points not remote from each auxiliary reservoir*" (p. 759, last paragraph.)

The patent describes the accomplishment of this by placing discharge-valves at intervals in the train-pipe, these valves being opened by a *fall of pressure in the train-pipe*, just as in modern practice.

In the course of taking testimony in this cause defendants proved, by the equipment of a rack containing fifty brakes provided with this "quick-action element" of 1879, that these devices were

operative and that the time of full application of all the brakes was reduced thereby to less than half (p. 695. Q. 8.) Exception has been taken by Complainants to the conclusiveness of these tests, and they rely on expert testimony to the effect that the device invented by Mr. Westinghouse, and patented by him in the 1879 local-vent patent as a new and useful invention, was in reality an *inoperative* contrivance. This contention is not established by the testimony, but the controversy need not be pursued here, for the material matter is fully proved by the testimony of Mr. H. H. Westinghouse, who proceeds to describe what was done immediately after the Burlington trials of 1886. He describes, at the bottom of page 123, the operation of the old automatic brake, with its triple-valve mechanism and piston, pointing out that "it is only for *emergency* or quick stops that the final and complete movement of this piston and valve is required." He then says (p. 124):

"Advantage was taken of these conditions to arrange an
 " *auxiliary device* controlling communication between the
 " train-pipe and the *atmosphere*, which was caused to operate
 " *by the final or complete travel of the piston of the triple valve*
 " when a considerable reduction of pressure was made at one
 " end of the train-pipe for emergency or quick stops. With
 " the aid of this device there was a complete exhaustion of the
 " air from the train-pipe at each triple-valve, which accelerated
 " the operation of the brakes *to a degree that reduced the time*
 " *of full application on the last car from twelve seconds to six.*"

Particular attention is called to two facts here stated by Mr. Westinghouse: *First*, that the arrangement by which this result was accomplished employed the old means of *local venting in the form proposed in the 1879 local vent patent*, that is to say, the vents in the train-pipe discharged *to the atmosphere*; *second*, that the auxiliary-valve device which controlled the vent in each brake was "CAUSED TO OPERATE BY THE FINAL OR COMPLETE TRAVEL OF THE PISTON."

Here we have the "final or complete travel of the piston," operating the discharge valve of the 1879 local-vent patent. It would seem quite natural to employ this organ for this purpose, seeing that the office of the piston always has been to operate the valves of the brake mechanism, and one valve, more or less, would seem to make

no great difference; but, as will presently appear, the official tests showed that the piston was not capable of opening the discharge valves with the requisite promptness.

It will be noted that this result, obtained by the means disclosed by the 1879 local-vent patent, absolutely confirms the correctness of Mr. Boyden's conclusions. It is with *this result*, namely, application of all the brakes of a fifty-car train in *six seconds*, that the result obtained by the brake of the patent in suit is to be compared.

The cut opposite this page illustrates the arrangement here described by Mr. Westinghouse. The parts are in all respect like the corresponding parts of the patent in suit, with the exception that the discharge passages, vent to the atmosphere. It will be noted that, when this construction is modified by connecting the end of the passage H which discharges to the atmosphere so that it will discharge to the brake-cylinder, as indicated by dotted lines, the operation of the piston remains unchanged.

This arrangement, in which the "further traverse of the piston" *operates an auxiliary discharge valve permitting air from the train-pipe to discharge to the atmosphere*, does not appear by any evidence in the case to have been the invention of Mr. George Westinghouse, Jr., and we have reason for asserting that no such contention will be made by the other side. It suffices for our purpose that this arrangement is *excluded* from the patent sued on, which is in terms limited to that modification thereof wherein the passage controlled by the auxiliary discharge valve *connects with the brake-cylinder*.

From this testimony we can also get the measure of the distinctive new departure pointed out in the patent sued on, and which is the salient feature of every claim, to wit: leading the passage, through which the train-pipe air discharged at each brake, to the *brake-cylinder*, instead of to the *atmosphere*.

In the next paragraph to that last quoted (p. 124) the witness (H. H. Westinghouse) describes as the next step in the progress of development of quick-action brakes, the invention of the patent in suit, which he appropriately terms a "modification" of the arrangement last described.

The effectiveness of the invention patented in the 1879 local-vent patent to produce the desired effect, *i. e.*, to cause "nearly uniform application of all brakes *practically coincident* with the exhaustion of

Cut of arrangement described by H. H. Westinghouse, whereof the
 Invention of the Patent sued on is a "modification."

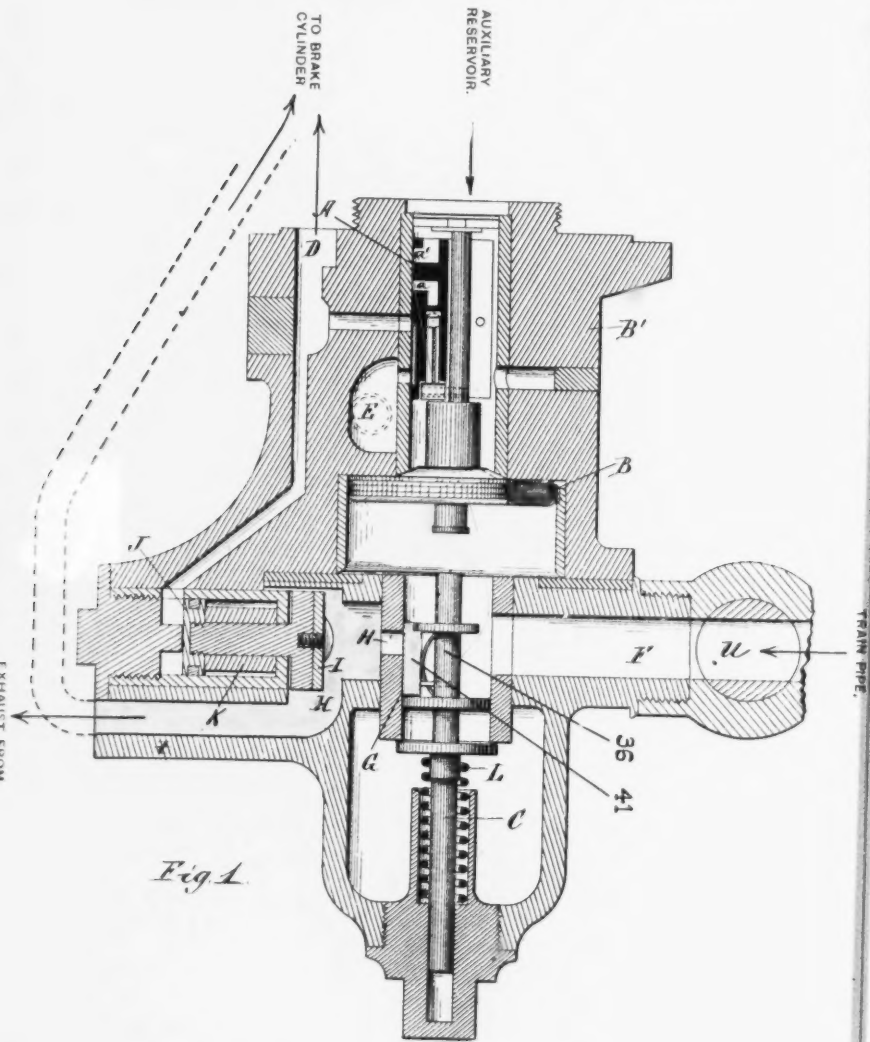


Fig. 1.

The Auxiliary Valve venting to atmosphere operated by the further traverse of the
 piston. (H. H. Westinghouse, Dep. p. 124, line 3.) Auxiliary Valve and discharge passage
 colored Red.



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air at the forward end of the train-pipe" was experimentally demonstrated before taking any step in the construction of these test brakes. Mr. Westinghouse says (p. 123):

"By placing in the train-pipe at regular intervals a form of delicately adjusted exhaust-valve, it was found possible to cause them to operate by the moderate reduction used in 'service' applications. The operation of these valves caused air to be exhausted from the train-pipe, *wherever they were located*, and their action being *nearly simultaneous*, the effect of their operation was to cause *a nearly uniform application of all the brakes practically coincident with the exhaustion of the air at the forward end of the train-pipe.*"

It clearly appears then that it only remained to determine by trial whether the auxiliary discharge-valves could be opened promptly by the triple-valve piston. What would happen if they were promptly opened was already well ascertained.

The test of the invention of the patent in suit then was a trial of the ability of the triple-valve piston to attend properly to the duty of opening *this new valve*, in addition to the like duties it performed for the other valves.

The witness proceeds to testify (p. 125) that a train of fifty cars was equipped with brakes constructed on the plan of the patent in suit, for the purpose of the second trials, which occurred at Burlington in May, 1887.

Exhaust-valve mechanism was also provided "to be operated by electricity, capable of being inserted in the train-pipe as frequently as circumstances proved necessary." *Two* of these valve devices placed at regular intervals in the brake-pipe, were found to be sufficient to produce an *instantaneous and uniform application of all the brakes of a fifty-car train* (p. 125.)

The results obtained by the system when using the discharge-valves venting to the atmosphere and operated by electricity were, in the words of Mr. Westinghouse, that "*the desired coincidence of operation was secured* and stops were made *without perceptible shock*" (p. 126.)

The official report states that:

"This type of brake possesses four distinct advantages:

"(a) It stops the train in the *shortest possible distance*.

"(b) *It abolishes shocks and their attending damage to equipment.*"

"(c) *It releases instantaneously.*

"(d) *It can be graduated perfectly.*"

On the other hand, the result obtained by the brakes of auxillary-valve patent in suit as compared *with the old automatic* tried the previous year was, in the words of Mr. Westinghouse (p. 126), that—

"the shocks experienced in the preceding year were *greatly exceeded*; reaching a maximum of 103 inches, as compared "with the maximum of 49 inches in the 1886 trials."

The result, in the words of the official report, was to "*leave the field for improvement as wide open as it was in 1886*" (p. 126).

The result in the direction of securing "*the desired coincidence of action*" was that "*the interval of application between the first and last cars of the test train was reduced from twelve to six seconds*" (p. 125). That is to say, the mechanism of the patent sued on did not gain in the direction of securing "*coincidence of action*," which was the one thing "*desired*" after the trial of the old automatic in 1886, *a fraction of a second* over the brakes provided with the old means of venting *to the atmosphere*. Compared with the old automatic *not provided with the quick-action device of the 1879 local-vent patent*, the violence of the shocks was *more than doubled*; and compared with the electrically operated valves *venting to the atmosphere* the former was a complete failure,—the latter a perfect success.

What new result, then, can be justly claimed for this invention? The result which Complainants claim is that *compared with the brakes tried in 1886* it stopped a train in 200 feet instead of in 350. This is extolled in Complainants' brief as a wonderful result, and it is therein ascribed to the venting of air *into the brake-cylinder*. The pertinent fact in this connection is entirely obscured, and a fictitious gain is set up, when in reality there was none at all. The comparison from which this conclusion is drawn was *not* with the old automatic provided with the *existing quick-action means of local-vents in the train-pipe*, but with the old automatic *just as it was constructed for short passenger trains*. To determine the gain in promptness of individual, as well as of serial application, over what had been previously attained, or what could be attained by means then known, the comparison should have been with brakes having local-vents discharging *to the*

atmosphere. By means of these devices, as testified by Mr. H. H. Westinghouse (p. 124) the time required for full application of all the brakes was *six seconds*.

The report of the committee, where it refers to the *shortness of the stop* effected by the brakes of the patent in suit, uses as the standard of comparison *the old automatic brakes tried in 1886*, which contained no provision for acceleration. The report says (p. 128):

"These stops may be considered as phenomenal in their
"shortness, which becomes all the more evident *when we com*
"pare them with the best results obtained in 1886,"

and adds that—

"the brilliancy of this record was *completely spoiled* by the
"fearful shock given at the rear end, the slidometer moving
"it will be observed, from 70 to 103 inches." (P. 128.)

This result, namely, an apparent advantage over a device *not equipped with the known means of local venting to the atmosphere*, and even this dubious triumph, *completely spoiled* by the fearful shocks, is a good enough basis, in the opinion of Complainants' counsel, for a claim of extraordinary merit for the invention of the patent in suit.

But the very next table in the official report of the Master Car Builders gives the result in *quickness of stopping* obtained by the brakes when provided with discharge valves (operated electrically) *venting to the atmosphere*. We find that under the *same conditions* wherein the brake of the auxiliary-valve patent in suit stopped the train in 200 feet, with "fearful shock," the train equipped with the two local vents stopped it in 139 feet, without shock. And the report adds:

"Now comes the still more astonishing story: In these
"electrical stops *the slidometer never moved*, and this with the
"same cars, the same leverages, and the same pressures, the
"only difference being *the time of application*."

We have, then, presented upon the best authority the practical results attained by discharging the train-pipe to the brake-cylinder when using the brake to make a quick stop. In respect of *bringing the train to a stop* the brakes of the patent were phenomenal in their *quickness when compared with the plain automatic-brakes tried in 1886*, and phenomenal in their *slowness* when compared with the same

brakes provided with the local vents discharging to the atmosphere, which vents had quick-acting (electric) motor devices. As to *quick-ening the serial application* of the brakes, the means of the patent in suit gave *exactly the same result as the atmospheric venting-brakes when operated by the same means* (reduction of train-pipe pressure), and results far inferior to the train equipped with electrically-operated vents. As to *shocks*, the invention of the patent more than doubled the violence of the shocks produced by the *old automatic*, which latter had four times the intensity found to be injurious to cargo and equipment, whereas, with the local-vents, the train was stopped without shock great enough to produce any effect on the registering device.

Plainly, then, the claim that this invention is the "pioneer quick-action brake" rests on nothing at all. The invention did not produce a "quick-action brake," nor did it advance the art one hair's breadth towards that result. The gain in this respect *over the old automatic* was due to getting the air quickly out of the train-pipe, (which, with the means for doing it, *was old*), and not in the slightest degree to the use of the air thus discharged in the brake-cylinder. The experiments, as testified by H. H. Westinghouse, showed that precisely the same result in respect of quick *serial* application was produced whether the train-pipe discharged to the brake-cylinder or to the atmosphere.

From these facts we can determine with absolute certainty the *cause* of "quick-action," as produced in the modern air-brakes. That *cause* is the rapid and uniform reduction of pressure in the *entire length* of the train-pipe. *One* of the agencies through which that cause operates in the Westinghouse brake to produce that result we have already seen in the prior art, to wit: local discharge valves in the train-pipe. We have also seen that another co-operating agent was required in order to produce the result by the action of compressed air alone, namely, a *quick-acting motor* for the discharge-valves—a motor that would act with approximately the promptness of the electric actuating devices. When, and in what form this needed agent was devised by Mr. Westinghouse, will shortly appear.

These trials occurred six months after the application for the patent in suit had been filed, and two months after the patent itself issued. The invention was fully matured, and, indeed, there had been abundant opportunity for improvement. Did it accomplish

"the desired consummation," or even give promise of its accomplishment? Mr H. H. Westinghouse says (p. 127) that:

"The beneficial effect of the use of the *electric valves* was so marked that it apparently *seemed to the committee* to be the *only direction* in which to seek for the desired consummation."

The committee were certainly competent judges; but this belief, according to this witness, was generally shared "by those conversant with the subject. He says (p. 129):

"The improvement in respect to the time of application between the first and last brakes was so great between the 1886 and 1887 trials* that it was *not generally believed by those conversant with the subject who witnessed the tests* that a further change sufficiently great could be made to cause the quick-action apparatus to come within the prescribed requirements without the aid of electricity."

The judgment of all who witnessed these thorough trials of the brake of the patent in suit was not only that it did not accomplish quick-action, but that quick-action *could not be accomplished without electricity*. This was the point that was reached when the invention of the patent in suit was fully tested.

THE UTILITY OF THE INVENTION OF THE PATENT IN SUIT.

In demonstrating, as we think has been done, that discharging the train-pipe into the brake-cylinder is not the *cause* of which "quick-action" is the *effect*, we do not necessarily assert that that operation was without *utility*. On the contrary, it had and has utility, as may reasonably be inferred from the fact that it is found in the successful brakes of both the parties to this suit. The utility of this "modification" is said by Mr. H. H. Westinghouse (p. 124) to be, *first*, that it *saved and utilized* air that was *wasted* when the train-pipe was discharged to the atmosphere; and, *second*, that the pressure obtained from the train-pipe for emergency purposes augmented that from

*The change by which this supposed ultimate improvement was effected consisted in putting into use the invention of the 1879 local-vent patent.

the auxiliary-reservoir about twenty per cent.* The first consideration (saving *air*) is paltry in connection with an operation resorted to but rarely, and then only to save lives and property from destruction. The second consideration is more important, as it permitted the braking-power obtained from the auxiliary-reservoir to be *restricted* to that found most suitable for "service"-stops, supplementing that power by the air discharged from the train-pipe in making "emergency"-stops (H. H. Westinghouse, p. 124).

The tests showed that there was no *need* of augmenting the power of the reservoir for this purpose, but the "modification" described by the patent in suit had the advantage that it rendered it *unnecessary* to make provision for such a rapid flow of air from the auxiliary-reservoir as would otherwise be desirable in making an "emergency"-stop. This expedient, then, of directing the air discharged from the train-pipe into the brake-cylinder solved no problem, supplied no necessity, removed no hindrance that stood in the way of "quick-action." It enabled something to be done that was *desirable*, and therefore useful, but which was not necessary to "quick-action," and in fact contributed *nothing at all* to that result.

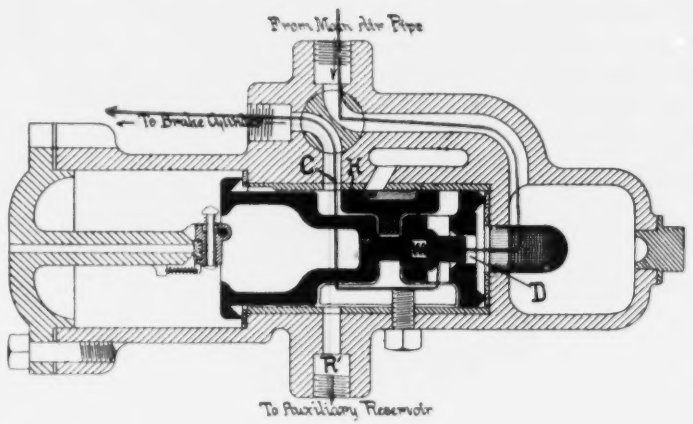
THE BOYDEN 1883 PATENT.

But it is material to ascertain at this point just how far the demonstrated utility of the invention patented in No. 360,070 in suit had been accomplished previously thereto. At this point attention must be given to Boyden's patent of 1883, No. 280,285 (p. 776) and its precise bearing upon the question under consideration, must be determined.

This patent (which we will call the "Boyden 1883 patent") shows that the brake of the auxiliary-valve patent in suit was not the first in which, *when the piston made its complete traverse*, a passage was opened from the train-pipe to the brake-cylinder, so that air could pass directly from the former to the latter.

*The method of exaggeration employed by Complainants' counsel is exemplified by frequent statements to the effect that, by the patented invention, an emergency passage to the brake-cylinder was opened "through which the *train-pipe* air *in bulk* could pour into that cylinder" (p. 17, italics are in the original). According to Mr H. H. Westinghouse the auxiliary reservoir contributes 80 per cent. of the air and the train-pipe but 20 per cent.

Boyden 1883 Patent.



The piston has made its complete traverse, which opens wide the Main Valve through which both Auxiliary Reservoir Air shown by a Yellow line, and air from the Main Air Pipe shown by a Blue line, pass to the Brake Cylinder—just as in the Defend structure.

The construction of this valve mechanism is shown in the accompanying diagram. It may be regarded as in all respects an ordinary triple-valve, and no explanation of any part will be required except with reference to *the passage through the piston from the train-pipe to the valve-chamber*, in which passage is the check-valve D. The operation of this device is such that, whenever the pressure in the train-pipe *exceeds* the pressure in the valve-chamber, air from the former passes through said passage into the latter; *and whenever the main-valve H is open*, the air thus admitted to the valve-chamber, passes freely to the brake-cylinder. Attention is particularly called to these conditions because they are *precisely those which exist in the Defendants' "quick-action brake."*

Since check-valve D always prevents back flow from the valve-chamber to the train-pipe, the passage in which it is placed is said in the patent to be "always open one way only." This condition is also *exactly duplicated* in Defendants' quick-action brake, so that anything in these respects which differentiates the brake of the "auxiliary-valve" patent in suit, No. 360,070, from the Boyden 1883 patent, equally well differentiates Defendants' quick-action brake from the brake of the patent in suit.

It will further be noted that the passage from the train-pipe to the brake-cylinder is opened when, and only when, the piston has made its extreme movement, moving valve H to such position as to uncover fully passage C leading to the brake-cylinder; in other words, *opening the main-valve*. In this, too, there is perfect coincidence between this Boyden 1883 patent and Defendants' "quick-action brake."

There is no pretense by Boyden that, when he invented and patented this brake, he had any idea of thereby quickening the action of the brake. Doubtless, in the use which is now made in great emergencies of the air admitted directly from the train-pipe to the brake-cylinder, there is *greater utility* in opening a direct passage between these points than in any use which Boyden had in mind in 1883. But he *was the first to open that passage when the piston made its final traverse*, and he is entitled to all the benefits and utilities thereof.* He

* Roberts vs. Ryer, 91 U. S., 157; Potts vs. Creager, 155 U. S., 606.

did it in 1883 without an auxiliary-valve, and he does it now without an auxiliary-valve.

Whatever of merit, therefore, there may be in *opening a passage through the triple-valve from the train-pipe to the brake-cylinder by the final movement of the piston*, that operation was performed in the brake of the Boyden 1883 patent. The argument of Complainants' counsel in this connection is plainly based on an unwarranted and false assumption, viz., that the discharge of the train-pipe *into the brake-cylinder* is the *cause* of quick-action, thus arguing from the assumption that Westinghouse used this old operation to produce a new *effect*, and is entitled to monopolize the operation for *that* purpose. Having shown that the assumed relation of cause and effect *does not exist*, the argument is left without support.

The distinction between this Boyden 1883 patent and that of the auxiliary-valve patent in suit upon which Complainants' counsel mainly insist is that this Boyden 1883 patent is a "non-quick-action brake," and that Boyden did not by that invention discharge air directly from the train-pipe to the brake-cylinder "*to produce quick-action.*" The sufficient answers are that the public official trials in 1887 of the brake of the patent in suit conclusively proved that it was equally a "non-quick-action brake," and that if Westinghouse did in fact discharge the train-pipe into the brake-cylinder "*to produce quick-action,*" (*i. e.* with the expectation that he would thereby produce quick-action) the *purpose* for which a thing is done does not confer novelty upon that thing if it be otherwise old,* particularly if it *failed to accomplish that purpose.*

A fact in this case which largely bears the weight of the charge of infringement is that, in Defendants' "quick-action" brake, the movement of the piston *has something to do with* the admission of air directly from the train-pipe to the brake-cylinder. It will, therefore, be very important to note that the piston in the Boyden 1883 patent has *precisely the same agency in this final result as it has in the Defendants' quick-action brake.* In both its exact contribution to that result is *to unseat the main-valve.*

*Walker on Pats., 3d Ed., p. 182; Crescent Brewing Co. v. Gottfried, 127 U. S., 168.

Finally, it is to be noted that the inherent capacity and law of action of this 1883 device is to admit air directly from the train-pipe to the brake-cylinder whenever a lower pressure exists on the valve-chamber side of the piston than on the train-pipe side thereof and the main-valve is open. What Boyden did to produce his quick-action brake was to provide means whereby this difference of pressure can be momentarily created *at the time when it is desired to effect a quick-stop*. Westinghouse invented no such "means," or agencies for this purpose, or for any purpose.

THE INVENTION OF THE WESTINGHOUSE PATENT

No. 376,837.

Recurring now to the condition of things which existed after the second Burlington trials, as stated by Mr. H. H. Westinghouse, it is clear that what was then needed to make the Westinghouse brake a "quick-action" brake was *a quicker motor device for the discharge-valves of the train-pipe*—something that would produce proximately the effect of the instantaneous electrical-actuating devices. It was conclusively shown by these tests that whether the train-pipe discharged to the atmosphere or to the brake-cylinder was a matter of indifference. One way, equally as well as the other, would accomplish "quick-action," *provided a quick-acting motor could be invented*. That was all that was needed *before the invention of the patent in suit*. It remained *just as much a necessity after the invention of that patent*.

On the production of this *quick-acting motor* for the discharge-valves the great energies and resources controlled by the Complainants were now concentrated "by the direction and under the supervision of George Westinghouse, Jr.," (p. 129.)

The expenses and labors devoted to the solution of this unsolved problem, as described by Mr. H. H. Westinghouse (pp. 130-132), were enormous, occupying the time from the middle of May to the latter part of September, 1887. During that period *"all the resources and employees that could be used were kept at work day and night without cessation*, and the materials for trial each time, involving more than a car-load, were conveyed from Pittsburg to Burlington by express, so that no time might be lost."

The mother, Necessity, was in the throes of labor with a *great invention*. In due course it was brought forth, and it was patented to George Westinghouse, Jr., and became and is the exclusive property of Complainants. There is no pretense that Defendants have employed this invention.

This successful quick-acting motor for the discharge or "auxiliary"-valves, which enabled all the discharge-valves of a fifty-car train to be operated in *two seconds*, without the use of electricity, is the "supplemental-piston" patented in patent No. 376,837, dated January 24, 1888. We shall call it the "supplemental-piston" patent.

It was, therefore, with some justification that the invention of this supplemental-piston patent was hailed as a great invention that overcame great hindrances. It was with some justification that the New York courts held, on the demand of Complainants and on the evidence they produced, that this *later* patent was the "pioneer quick-action brake," was "*the bridge which carried car-builders from failure to success.*" It was, undoubtedly, the patent which produced the agent that was needed to enable the cause of quick-action (local-venting) to produce that *result*.

This view also finds some support in the decisions of this Court. As tersely put in the Barbed Wire Fence case (143 U. S., 283). "*In the law of patents it is the last step that wins.*"

But there is *no* justification here for the assumption that pervades the argument of the other side, and finds expression at numerous points in their brief, to the effect that the invention which accomplished the great result of effecting practically simultaneous application of all the brakes on a train of fifty cars was the invention of the "auxiliary-valve patent in suit."

We have now presented the facts with reference to the results produced by the invention of the patent sued on, and we have stated them with great detail, and *solely from the evidence produced by Complainants*, in order to determine, with the nearest possible approach to certainty, just what basis the evidence affords for the claim that the invention of this patent is "the pioneer quick-action brake." We have from these facts to deduce an answer to the question which Complainants have put in issue and made material, and indeed have made the basis of the con-

tention that the patent sued on should be construed broadly for the method or process of discharging air, by the further traverse of the piston, into the brake-cylinder instead of to the atmosphere. That basis is that it was done "to produce quick-action." They are careful not to say that Westinghouse was the first to discharge the train-pipe to the brake-cylinder, *thereby producing* quick-action; but that is what they wish the Court to infer.

Briefly summing up the material facts with reference to the development of the art to the point of the production by Westinghouse of the "quick-action brake," we find that the old automatic in common use had but one discharge opening for the train-pipe, and that if the pipe were the length of fifty cars it required twelve seconds for the air to escape through that one door. Westinghouse had perceived this limitation, and also the way to remove it—namely, by providing a number of doors along the train-pipe, and he had devised means consisting of *supplemental-pistons* for opening these doors, the pistons being operated by the reduction of train-pipe pressure. All this was in the "local-vent" patent of 1879. When this plan came on trial in 1887 it was found that the actuating devices adopted for opening these doors, by reduction of train-pipe pressure (namely, a mechanical connection with the triple-valve piston,) did not work fast enough. It was also found that, if prompt-acting means for opening the doors could be provided, the plan of local venting would be an entire success on a fifty-car train. Mr. Westinghouse thereupon invented and patented in 1888 the "supplemental-piston" as a means for opening these doors. This proved an entire success.

Thus in the actual development of this art, as shown by the testimony offered by Complainants, the auxiliary-valve *operated by the piston of the triple-valve*, has no place at all. After the 1887 tests none of these devices were ever manufactured or put into use. R. p. 149, L. 36.

IS PATENT NO. 360,070 IN SUIT, A PIONEER PATENT?

The answer to this question is read on the face of the facts stated above, but we have to notice the attempt of Complainants' counsel to read a different answer therefrom. This attempt will be disposed of by applying the following principle, which we submit is the law of the discussion on this point:

The earlier and later patents of Westinghouse and the results attained by them, cannot be considered in this case except for the purpose of limiting and defining the scope of the patent in suit, and for that purpose their effect is practically the same as if they were patents of another person.

How important it will be to apply this principle, if it be sound, will presently appear, and the importance of the principle involved justifies our dwelling for a moment upon it.

The principle is that stated and applied in *James v. Campbell* (104 U. S. 356) and is based on the fact that the merit due to inventions of other patents can only be recognized in suits where such other patents are involved. In this instance the patentee can no more borrow credit from the achievements of his other patented inventions for the purpose of inducing the Court to greater liberality in construing the patent in suit, than he can borrow for that purpose from the inventions of others. The patentee stands before this Court, upon this patent, *precisely as if the invention of the supplemental-piston patent, No. 376,837, had been made by another, or had never been made at all.**

Our proposition is that if the patent in suit were a pioneer, it was such *from the moment it was granted*. Its status and its scope were *then definitely and forever fixed*. These could not possibly depend upon what might or might not be subsequently done by the patentee (or by others) in the near future, or in the remote future. Otherwise we commit ourselves to the absurdity of holding that a patent which is not a "pioneer patent" may subsequently become such in consequence of a later invention, itself the subject of a patent.

*Attention is here particularly directed to that part of the main brief of complainants' counsel which begins at p. 30 under the caption, "THE INVENTION OF WESTINGHOUSE OF THE QUICK-ACTION BRAKE IS A 'PIONEER' INVENTION, OR ONE FUNDAMENTAL IN CHARACTER," and extends to p. 38. Underlying all this argument is the assumption that the credit due to the *later* invention, and the result which it brought about, can be considered in support of the patent here in suit, just as if defendants were charged with infringing the later patent.

This is the proposition which the other side offers to the Court to reconcile their claim of pioneership with the facts demonstrated by the Burlington trials. After a slighting reference to the "defects" of the brake of the auxiliary-valve patent in suit, they argue (p. 37) that, notwithstanding the pronounced inadequacy and failure of the patented invention to produce any advance towards "quick-action," the legal consequences are the same as if the invention had completely solved the problem, because these defects were

"shortly remedied by the same inventor, and so promptly and perfectly remedied that at the time the testimony was taken between 1,500 and 1,800 of these valves were in actual use."

But the remedy invented "by the same inventor," and which made his apparatus a "quick-action brake," was patented to him in No. 376,837, and the facts here brought forward were urged upon the New York Courts, and accepted by the latter as establishing that *this later* patent was the "pioneer quick-action brake" patent. Therefore against the assumptions of the foregoing passage we maintain that whether the successful invention "promptly" followed that which failed, or came only after a long interval; or whether it was made "by the same inventor," or by another, or never made at all, are matters which have no influence whatever in determining the scope of the patent in suit. The results achieved by the *later* invention (No. 376,837) confirm and emphasize our position. The ascertained merit that belongs to *it*, for the production of that which was needed to endow the mechanisms existing *before* the invention of the patent in suit with "quick-action" renders it impossible to ascribe to the latter the merit now claimed for it.

The argument of Complainants' counsel which we are now considering would as readily, indeed *much more readily*, demonstrate that No. 217,838, of July 22, 1879, which disclosed "local-venting" of the train-pipe, was the "pioneer quick-action brake patent." The testimony of Mr. H. H. Westinghouse shows that the quick-action means of this patent reduced the time of application from *twelve* seconds to *six*. This is the means which, with the supplemental-piston of No. 376,837, make the modern quick-action Westinghouse brake; and this means is public property. The auxiliary-

valve patent in suit gave no action quicker by a fraction of a second than this. It was merely a lateral excursion from the true line of development of quick-action—a plunge in the wrong direction—failing to give that which was sought, but giving the incidental advantage of economizing air, and supplementing the power of the auxiliary-reservoir, which had already been done in the Boyden 1883 invention.

Between the local-vent patent, No. 217,838, and the supplemental-piston patent, No. 376,837, there may be a legitimate dispute as to the claim of pioneership. The first disclosed the means for rapidly depleting the pressure of the train-pipe, namely local-venting. The latter disclosed what the former lacked, namely practical means for opening the vents with the requisite promptness. One disclosed the principle and *one* of the agents necessary to carry out that principle in practice; the other made the first effective and successful by supplying the *other* needed agent, thus producing a practical embodiment of the invention. But the patent in suit did neither the one nor the other, nor contributed in the slightest degree to either. It has no shadow or color of right to claim pioneership. It is an impostor, with no merit to support its pretensions to pioneership except what it has wrongfully appropriated from other inventions.*

In 1890, Complainants brought suit against the New York Air-Brake Co. for *infringement of the later supplemental-piston patent*, No. 376,837. Here they found a manufacturer of a "quick-action brake" who apparently did not infringe what is, in this suit, Complainants' fundamental, pioneer, quick-action brake patent, which itself is a significant circumstance. Complainants in that suit had to make a judicious distribution of the merit they claim between these two patents, in such proportion that No. 376,837 should get the bulk of it; and they did so. The deposition of H. H. Westinghouse, from which we have freely quoted, was given in the New York case, and

*Opposing counsel refer in their brief to the Bell Telephone and the Mergenthaler Linotype in illustration of the principle that a great and primary invention need not appear in the patent in a perfected form. It is, however, requisite that the means disclosed by the patent should be *fully adequate to accomplish the intended result*. The difficulty with No. 360,070 in suit was not that the apparatus described was "crude," it was anything but crude. The difficulty was that it lacked, *just what the local-vent 1879 patent lacked*, means for promptly opening the vents through which the air could escape from the train-pipe.

from that and all the evidence, the Court was convinced, and so adjudged, that the later patent disclosed the meritorious, primary invention that resulted in the "quick-action brake," and was the pioneer patent. The Circuit Court of Appeals (by Judge Shipman) said:

"The patentee was a pioneer in that he designed in No. 376,837 a new way to accomplish a desired result, but upon the same general idea that he had *unsuccessfully* tried to work out in the earlier patent. His *later patent was the BRIDGE, and not a mere step, which carried car-builders from failure to success.*" (63 F. R. 969.)

Afterwards the Defendants in New York changed their construction and were sued under No. 360,070, the auxiliary-valve patent in suit. Then a redistribution of the merit became necessary, and Complainants were equal to it. But the Court having held that No. 376,837 was the *whole bridge*, could not ignore that conclusion, and hence in the last decision, Judge Lacombe, referring to the previous adjudications, says:

"In these opinions it is held that the two patents, 360,070 and 376,837, disclosed one the emergency-valve, the other the supplemental-piston or special motor, which so far as the art has now progressed, appear to be *both essential* to the *structure* of a successful quick-action brake.* Both these inventions achieved great necessities and overcame great hindrances; each is an *INDISPENSABLE* part of the bridge which carried car-builders from failure to success." (65 F. R. 100.)

In the present suit it is necessary to put forward the earlier auxiliary-valve patent No. 360,070, as *the bridge*, the supplemental-piston patent being introduced casually in the brief as "a subsequent and in some respects *less important* invention of Westinghouse," (p. 33); and the merit is *again* redistributed, going this time in bulk to No. 360,070, in suit.

*Judge Lacombe evidently was not aware of the construction of the Boyden Brake, which employs neither an emergency or auxiliary-valve nor a supplemental-piston or special motor. Since Boyden admittedly does not use the latter it is manifest that he produces the same result (quick action) by means different from those of Westinghouse, for he at least omits what in the latter cannot be dispensed with.

Complainants have thus, at different stages of their litigation, assumed three different positions upon this question of pioneership. First they convinced the Circuit Court of Appeals (Second Circ.) that No. 376,837 was the genuine pioneer. This "*later patent*" they held was "*the bridge on which car-builders crossed from failure to success.*" Afterwards they secured judicial sanction to the proposition that "*each was an indispensable part of the bridge.*"

Either of these propositions would be fatal to the pretensions here, for they cannot charge that Defendants have used the invention of the later patent, which was first the *whole bridge*, and afterwards an *indispensable* part of it. Acceptance of either of these propositions would carry us at once to the conclusion (which by patience will be reached with certainty) that Mr. Boyden crossed *on a bridge of his own*, using what was public property to carry him as far as it would go, and adding, by his own inventive genius, what was required to complete it.

In this suit then, Complainants take their third position, which is that the auxiliary-valve patent in suit is the *genuine* pioneer, the *real* bridge, and that No. 376,837 is neither *the bridge* nor an *indispensable* part of it, but merely a matter of decoration or architectural embellishment.

In establishing two of these contentions, Complainants have succeeded. If they succeed in establishing the third, it will be one of the most remarkable results ever attained by legal ingenuity.

We feel justified in concluding from the foregoing that the auxiliary-valve patent in suit, No. 360,070, is *not* the pioneer patent for "*the quick-action brake.*"

If, then, the broad interpretation which Complainants ask of the patent in suit depends upon the benefit of a rule of interpretation applicable solely to "*pioneer patents,*" the question propounded by the Court is already answered.

But it may be said that, conceding this invention to be not of "*primary*" character, and that it failed completely to accomplish that for which it was solely designed, nevertheless the novel means it disclosed and which produced a result of *some* practical utility may afford the basis for a claim to a process or method, or to some broad means, which claim may be infringed by Defendants. This question will

therefore be considered independently of the question of pioneership, but with reference to the terms of the patent and to the prior art.

CAN PATENT NO. 360,070 IN SUIT BE SUSTAINED AS TO PROCESS OR METHOD?

The effort is to construe Claim 2 as for a process or method of admitting air directly from the train-pipe to the brake-cylinder when that operation is in some manner brought about by the further traverse of the piston. The operation is itself old, but the contention is that it is new to do it by the particular means specified, to wit, by the further traverse of the piston.

The claim is as follows:

"2. In a brake-mechanism the combination of a main air-pipe, an auxiliary-reservoir, a brake-cylinder and a triple-valve having a piston whose preliminary traverse admits air from the auxiliary-reservoir to the brake-cylinder, and which by a further traverse admits air directly from the main air-pipe to the brake-cylinder, substantially as described."

The proposition that a process, which consists in doing a certain thing (itself old) by a particular means or agency, is patentable under the law, has been frequently passed upon by this Court. Thus in *Corning vs. Burden* (15 How., 252), the claim was for "the preparing of the puddlers' balls * * * by causing them to pass between a revolving cylinder and a curved segmental trough adapted thereto."

The claim was in form for a process performed by particular agents, and the Circuit Court held that it was for "a new process of converting puddlers' balls into blooms." But this Court held that the novelty of the invention resided in the *mechanism* employed."

In *Crescent Brewing Co. vs. Gottfried* (127 U. S., 168), the claim was for—

"the application of heated air under blast to the interior of casks *by means* substantially as described and for the purpose set forth."

The Court held that this was "a claim for *mechanism* and not a claim for a process." And the Court distinguished from *Lawther*

vs. Hamilton, showing that the latter gives no countenance to claiming as a process the doing of a particular thing by a particular agent.

In each of the foregoing cases the agent specified in the claim was in fact that *which performed the particular operation claimed as a process*. Claim 2 of the patent here sued on is peculiar in that the operation attributed to the further traverse of the piston is not performed by that device at all, but by an auxiliary-valve and conduit.

If Westinghouse had, in fact, invented a new means for admitting air direct from the train-pipe to the brake-cylinder (this operation being itself old), and such means were the *piston*, he could undoubtedly have a patent broadly for those means; but even then he could not have a patent for the process of doing it *by means of the piston*.

An attempt is made in this claim to go beyond everything of which the reports give an account, and to claim the admission of air direct from the train-pipe, whenever the further traverse of the piston *plays a part* (however remote) in *actuating the real air-admitting devices*. This interpretation, by *ignoring and excluding* the real means by which the train-pipe air is admitted to the brake-cylinder, makes it *impossible to apply to the claim the uniform test for infringement*—the test which is applicable to patents of all grades, and was applied, for example, in *Morley Machine Co. vs. Lancaster (infra)* that test being, in the language of that decision, that “*each mechanism, individually considered, is a proper equivalent for the corresponding mechanism in the Morley patent.*”

In other words, the test sanctioned and uniformly applied by this Court requires us to find in Defendants' machine the “proper equivalent” of the “corresponding” air-admitting devices of the patent in suit. The interpretation of Claim 2 now under consideration says we shall do nothing of the sort, but shall adopt a new test, namely, whether in Defendants' machine some *one* of a train of mechanisms which *actuates* the air-admitting means, corresponds with a selected *one* of a train of actuating agents in the patent sued on.

We do not think the Court will accept this novel substitute for the settled rule of infringement; but if it did, the patent could not live under it, for this test would prove identity between Complainants' patent and the Boyden 1883 patent, in which the final traverse of the

piston has exactly as much to do with the admission of air from train-pipe to brake-cylinder as it has in Defendants' brake.

We could with equal propriety take for our test of identity the question whether, in the two cases, the engineer's valve has anything to do with the discharge of the air as specified, and argue that resemblance in such points establishes identity.

THE VICE IN CLAIM 2.

It is impossible for the mind to dwell long upon the terms of this claim without the conviction that there is *something* wrong with it, and that this entire litigation, with all its deplorable consequences, is directly due to the presence in the patent of a claim about the meaning of which it is possible to wage such tedious controversy, and which this Court is unable to interpret to its satisfaction after all the argument, explanation and illustration that have been lavished upon it. This in itself shows that the claim is not *specific* and *distinct*, as the law requires.

Can we not locate and identify the cause of this extraordinary difficulty? At least we will endeavor to aid the Court by offering the result of our efforts in this direction.

When the statute requires that a patentee shall "*specifically point out, and distinctly claim*" the novel means whereby he accomplishes his result, it calls upon him to state the *immediate or proximate cause* of the described effect, and the law is not satisfied by a statement of a *remote* cause. Even when the invention is of such breadth that it can be expressed in a general phrase, such as "feeding devices," "spacing means," or "sewing mechanism," * the general term specifies *that agent which DIRECTLY performs the indicated operation*—that is, the means which do the feeding, the means which do the spacing, and the means which do the sewing. A claim so expressed, though of the most extreme breadth, distinctly points out the *necessary elements* to be compared with other machines, in which the presence or absence of "*corresponding*" devices for feeding, spacing, and sewing, operating in the same way and performing respectively the same result, determines infringement or non-infringement.

* *Morley Machine Co. vs. Lancaster*, 129 U. S. 273.

Had Bell claimed transmitting articulate sounds *by means of electricity*, his claim would have been void, notwithstanding that he was *the first to accomplish this result by this means*, because he would then have specified the *remote* cause, and not the *proximate* cause. His claim was sustained because he specified his direct means, to wit, "an undulatory current corresponding in form to the sound waves."

Claim 2 of the patent in suit is vicious in that it ignores *the means which admit air directly from the train-pipe to the brake-cylinder*, and instead recites a movement of the piston which more or less remotely *assists in actuating* the air-admitting devices. Had the patentee claimed (as he did in other claims) his air-admitting means, as broadly as the state of the art allowed, the question of infringement would present no serious difficulty. But instead of thus doing in claim 2 what the law requires of him, he has confused and well-nigh baffled inquiry by attributing to the *piston* an office, operation, or action which it does not perform.

This explanation of the extraordinary difficulty which the construction of this claim has given to all the courts that have attempted to construe it*, and to all the counsel who have attempted to elucidate it, will more strongly commend itself to this Court when we come to compare the invention of the patent with Defendants' brake.

We therefore submit that the patent cannot be sustained "as to process or method" first, because the nature of the invention—of the result accomplished, and of the means that are employed therein—do not admit of interpreting the patent as for that process or method which is sought to be based on claim 2.

THE TERMS OF THE PATENT IN SUIT.

But the "terms of the patent," including the terms of this claim, equally preclude such interpretation of the invention, particularly with the light afforded by the proceedings in the Patent Office, and by the prior art. The patent expressly defines the extent of the novelty as consisting of certain "additional members," and specifies these additional members as the by-passage and auxiliary-valve. The specification nowhere hints or suggests that the inventor has discov-

*Judge Morris construed it as for a function, Judge Lacombe as including the auxiliary-valve, and Judge Hughes as "fatally defective" because lacking the essential elements.

ered a new sort of *piston*, whose novelty consists in that by one movement it admits air from one source and by another movement admits air from another source. There is no new sort of piston described, but *per contra* that member, in the minutest detail of its construction, is *identical with the pistons of the prior art*. The piston and its relation to the auxiliary-valve are correctly described, the former being presented as *one of a series of agencies through which the auxiliary-valve is actuated*.†

This accords perfectly with the known history of the invention. When Mr. Westinghouse sought to quicken the action of his old automatic-brake, he took that apparatus just as it is described in expired patent No. 220,556 (the old automatic triple-valve), and *added to it*—not a *new piston*, or a piston endowed with new characteristics, powers or functions—but a *new valve and a new conduit leading from the train-pipe to the brake-cylinder*. When we seek the novel means with a view to giving the inventor *those means and everything that is the equivalent thereof*, shall we not look to *what he added to the old structure*? Or shall we look to what was there before, and remains without a shadow of change in structure or function? In the case before us, whether we add the *new members*, or take them away, it works no change in the *piston*. The latter, in either case, makes its preliminary and further traverse, and the further traverse in either case displaces the old stem 36 and does nothing more.

We may now clearly see the *non-sequitur* involved in Complainants' argument. The office of the piston always has been to operate the valves of the triple-valve mechanism. If every time a new valve is added and mechanically operated by the piston it can be said that the piston performs a *new operation*, namely, *the operation performed by that new valve*, for precisely the same reason it can be said that the variation of train-pipe pressure performs that new operation, or that the engineer's valve performs that operation. Thus by adding a new port and valve to the triple-valve we have the foundation for saying that each one of these agents "performs a new operation," and we have as many *new processes* as there are agents in the series.

† To support the conclusion here stated we refer the Court to the specification of the patent itself which we have printed in colors at the end of this brief, with an analysis of its contents.

On the contrary, we submit the fact is as clear in respect of the piston as of each of the other old agents, that it performs no new function or operation at all, and that the agent of the new operation is that which was added to the old structure for the express purpose of performing it.

THE PROCEEDINGS IN THE PATENT OFFICE.

The meaning of the terms of the patent is, we think, unmistakable; but additional confirmation, if it be needed, will be found in the file-wrapper of the application (p. 706 *et seq.*).

Original Claim 1 (p. 714) was for the ordinary brake elements combined "with a *device* for admitting air directly from the main air-pipe to the brake-cylinder." This was rejected on Boyden's 1883 patent, cancelled, and present Claim 1 substituted (p. 717). This claim reads:

"1. In a brake mechanism, the combination of a main air-pipe, an auxiliary-reservoir, a brake-cylinder, a triple valve, "and an auxiliary-valve device, *actuated by* the piston of the "triple-valve, and *independent of the main-valve* thereof, for "admitting air in the application of the brake, directly from "the main air-pipe to the brake-cylinder, substantially as "set forth."

By the differentiations between the cancelled and substituted claims, attention was directed specially to the salient features of novelty as being the *addition* to the triple-valve of "an auxiliary-valve device," "*independent of the main-valve*," and "*actuated by* the piston."

When confronted with Boyden's patent, Mr. Westinghouse did not say, as his counsel now say, "my invention consists in a piston which is new in that it does something which the piston of a triple-valve never did before," but on the contrary he specifies with great precision his novel means for admitting air from the train-pipe, to wit, an auxiliary-valve device independent of the main-valve, and he specifies the true relation between these means and the piston, saying that the auxiliary-valve is "*actuated by* the piston." The piston then is not the new air-admitting means, but is merely the actuating device for the air-admitting means.

Claim 2 had also been rejected on Boyden's patent, and the inventor was called upon to point out an essential and patentable distinction. We quote this claim again :

" 2. In a brake mechanism, the combination of a main air-pipe, an auxiliary-reservoir, and a triple-valve having a piston
 " whose preliminary traverse admits air from the auxiliary-
 " reservoir to the brake-cylinder, and which by a further
 " traverse admits air directly from the main air-pipe to the
 " brake-cylinder, substantially as set forth."

Having put before the examiner a claim (new claim 1) in which the novel air-admitting means (the auxiliary-valve independent of the main-valve) conspicuously appeared, so that it was prominent in the examiner's mind, the inventor proceeds to argue upon both claims ; and in discussing *Claim 2* says :

" When, however, the triple-valve is *provided with an auxiliary-valve operated by its piston*, which performs a new function *additional to that of the triple-valve as previously employed*, " it is believed that *such combination* is wholly novel."

This virtually says to the office and to the public, " my claim extends to the use, additional to the triple-valve as previously employed, of an *auxiliary-valve*, operated by the piston. Outside of those limits every one is free from every assertion of claim under this patent."

Upon this construction of the claim the patent was granted to him, and under well-settled principles this precludes the patentee from asserting, and the Court from adjudging, that this claim covers the *process* of admitting air directly from the train-pipe to the brake-cylinder by a further traverse of the piston.

Sheppard vs. Corrigan, 116 U. S. 593.

Sutter vs. Robinson, 119 U. S. 530.

Roemer vs. Poddio, 132 U. S. 317.

Crawford vs. Heysinger, 123 U. S. 589.

Corbin Lock Co. vs. Eagl Lock Co., 150 U. S. 38.

Before the grant of the patent, moreover, the inventor inserted the following disclaimer (p. 720) : *

* See paragraph printed in green ink on folder at end of brief.

"I am aware that a construction in which 'an always open "one way" passage from the main air-pipe to the brake-cylinder is *uncovered* BY THE PISTON OF THE TRIPLE-VALVE "SIMULTANEOUSLY WITH THE OPENING OF THE PASSAGE FROM "THE AUXILIARY-RESERVOIR TO THE BRAKE-CYLINDER, has been "heretofore proposed, and such construction, *which involves "an operation different from my invention*, I hereby *disclaim*."

This effectually disclaims, not only the Boyden brake of 1883, but Defendants' quick-action brake, and particularly *that office of the piston of the latter which is now pointed to as constituting identity of Defendants' brake with the subject-matter of claim 2*. Defendants' brake, as we will presently see, admits air directly from the train-pipe to the brake-cylinder by the same "always-open-one-way passage," which is "*uncovered by the piston of the triple-valve simultaneously with the opening of the passage from the auxiliary-reservoir to the brake-cylinder,*" and the piston in Defendants' brake does nothing more than or different from this.

What complainants' counsel have contended for in this case is that a construction, in which a "passage from the main air-pipe to the brake-cylinder is uncovered by the piston of the triple-valve simultaneously with the opening of the passage from the auxiliary-reservoir to the brake-cylinder," is identical with the invention of the patent in suit. The patentee himself says in his specification that such construction is old (as it is), that it involves "an operation *different from*" his invention, and that he *disclaims it*.

THE PATENT CANNOT BE SUSTAINED AS TO PROCESS OR METHOD IN VIEW OF THE PRIOR ART.

Discharging the train-pipe to quicken the successive application of the brakes was not new, (Westinghouse 1879 local-vent patent). Discharging the train-pipe to the brake-cylinder simultaneously with the admission thereto of air from the auxiliary-reservoir was not new, (Boyden's 1883 patent). These are the only operations involved which could conceivably be processes. Neither is claimed. Effecting the discharge of the train-pipe by the movement of the piston is excluded from the patent, the modification which

claim 2 includes being that in which the end of the train-pipe discharge passage connects with the brake-cylinder. This is purely a matter of structure. Discharging the train-pipe to the brake-cylinder "*to produce quick-action,*" defines an operation with reference solely to the object sought thereby. This qualification would not confer novelty on an old operation, even if the stated object had been attained thereby, which was not the case.

The interpretation which this patentee himself put upon the prior art in preparing and prosecuting his application for the patent in suit, is specially significant because of his peculiar and accurate knowledge of that art. Being thoroughly conversant with that art particularly as developed by his own previous inventions, he made no pretense of any novelty in process or method, or in the operation of the piston, but set forth his invention as consisting simply of certain specific mechanism, whereby the old operation of locally discharging the train-pipe, and the other old operation of admitting air from the train-pipe to the brake-cylinder simultaneously with air from the auxiliary-reservoir when the piston made its full movement, were effected. The peculiar language of claim 2 offers no contradiction to this, for the attorney who drew it construed it to the Patent Office as a "combination" of the old triple-valve with "an *auxiliary-valve,*" operated by the piston, the latter thus preforming an additional office, that is, opening another valve *additional* to those of the triple-valve, as previously employed.

The specification sharply draws the line between his previous inventions and the new "structural features" disclosed by the patent in suit; but not being so familiar with the inventions of others, the patentee evidently thought he was entitled to claim the combination with the old brake elements of *any* "device for admitting air directly from the main air-pipe to the brake-cylinder" (original claim 1). When, however, attention was called to the Boyden 1883 patent, Westinghouse promptly struck out this claim and expressly stated that his new means consisted in an "auxiliary-valve," and specifically in one that was "*independent of the main-valve.*"

No suggestion that he invented in 1886 a new process or method, or any new operation of the old piston, nor anything capable of bearing that interpretation, ever proceeded from this patentee or

from those who represented him, until such a contention became necessary to support the charge of infringement in this case.

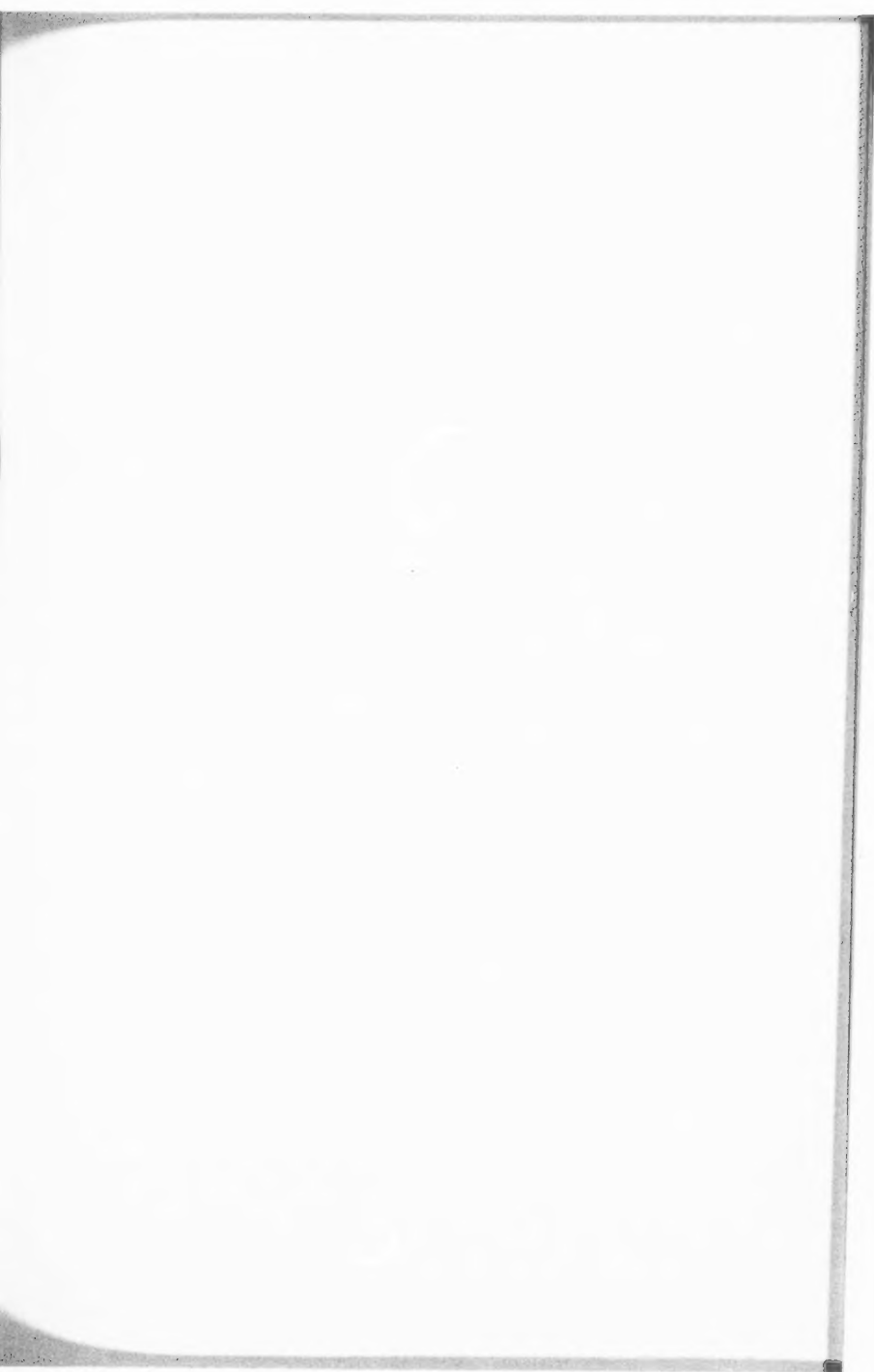
Because then of the state of the prior art, because of its own terms, and because of the proceedings in the Patent Office, the patent sued on cannot be sustained as to process or method.

To these reasons we will add another which will be briefly discussed hereafter, namely, that the patent cannot be sustained as to process or method under the settled law of this Court.

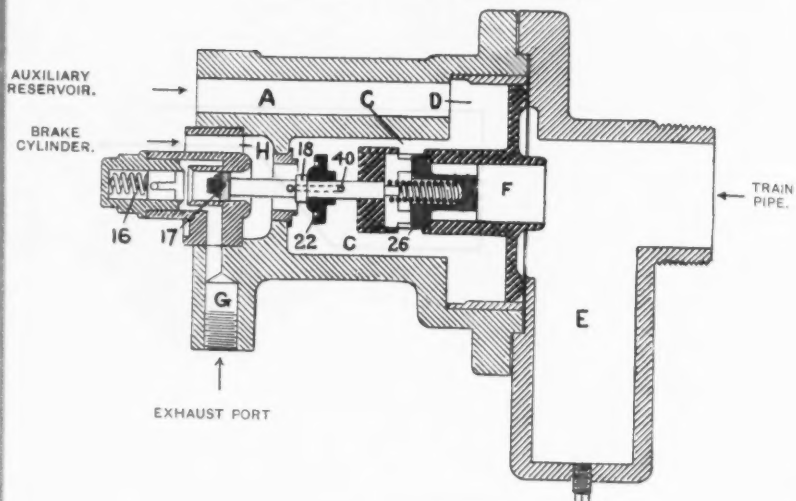
INFRINGEMENT.—DEFENDANTS' STRUCTURE.

We have seen how Westinghouse converted the automatic brake of expired patent No. 220,556 (the old automatic triple-valve) into a quick-action brake by adding to it the means for quickly depleting the train-pipe disclosed in expired patent No. 217,838, (*i. e.*, discharging the train-pipe under each car); and that the modern Westinghouse quick-action brakes, in their broad features, comprise a combination of the devices of these two patents. We have seen that, in bringing these two things together, Westinghouse first attempted to find their practical embodiment by *adding* to the mechanism of the old triple-valve of No. 220,556, an auxiliary-valve, and leading the passage controlled thereby to the brake-cylinder, operating this valve by the further traverse of the piston; that the second Burlington tests demonstrated that this invention did not supply the one thing needed, to wit, a quick-acting motor device for actuating the discharge (auxiliary) valves; that thereafter Westinghouse abandoned the use of the piston of the triple-valve as an actuating device for the discharge-valves, and substituted a new motor device, to wit, a *supplemental*-piston, which was patented to him in a later patent, No. 376,837.

We have now to show, as a matter of fact and history, how Mr. Boyden, starting also from devices existing previously to the invention of the patent sued on, developed a "quick-action brake" by means of an invention which made it *unnecessary* for him to invent or to employ, either an auxiliary-valve operated by the piston, as unsuccessfully attempted in the patent sued on, or a supplemental quick-acting motor for the auxiliary-valve, as successfully done in

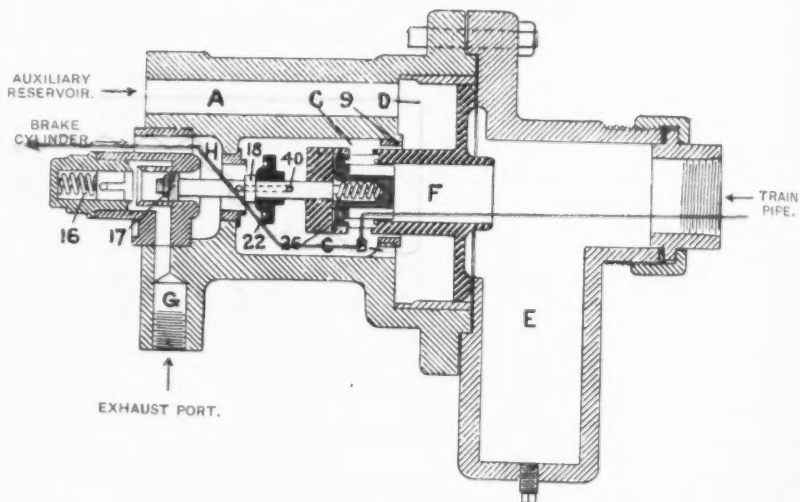


**The Old Poppet Form of Triple Valve 1873
incapable of Quick Action.**



Defendants Structure.

**The Old Poppet Form of Triple Valve, made capable of Quick Action
by inserting Boyden's Partition 9.**



In the upper cut the structure operates as a plain Triple Valve, the Main Valve 22 admitting only Auxiliary Reservoir Air to the Brake Cylinder as shown by the Yellow line, & in the lower cut the structure operates as a Quick-Action Valve. The Main Valve 22 admitting both Auxiliary Reservoir and Train Pipe Air to the Brake Cylinder as shown by the Yellow and Blue lines.

This great transformation in the operation being due to inserting the partition 9. With it, the Defendants Structure is a perfect quick-action device without employing any additional or "Auxiliary Valves" in any form, or their mechanical equivalents.

No. 376,837, or any equivalent for either of these devices, both of which are "*indispensable parts*" of the Westinghouse quick-action brake. This invention of Mr. Boyden develops latent but inherent capacities in the old triple-valve brake mechanisms, *leaving every moving part thereof exactly as it was before the patent in suit.*

What Mr. Boyden added to the old and common triple-valve mechanism was a stationary partition, separating the triple-valve chamber from the piston-chamber, this partition having through it an always-open passage of small cross-sectional area.

This simple structural change, *which added no new moving part, and altered no old moving part*, introduced into the old triple-valve a *new mode of operation, which we will now explain.*

The annexed cuts show the construction of Defendants' brake, and we will first briefly point out those parts which correspond in construction and operation with the old triple-valve mechanism (upper cut).

The feed-in valve 26, colored blue, is of the check-valve form, covering an opening through the piston to the valve-chamber. This form of valve is shown in Westinghouse patent No. 144,006 (p. 740), as well as in the Boyden 1883 patent. The main-valve 22 (black) is of the poppet form, and the release-valve 17 (green) is carried on the prolongation of the piston stem, the mechanism being in respect of these two valves like the Westinghouse patent, No. 141,685 (p. 736). The main-valve is provided with the sensitive-graduating valve (yellow) in the form of a passage in the sliding stem.

As thus constructed the apparatus operates in all respects like the old automatic triple-valve 220,556; that is to say, on a partial traverse of the piston the release-valve is closed, and the graduating member of the main-valve moves to a position which admits air gradually from the valve-chamber to the brake-cylinder through the main-valve port. Successive slight variations of pressure in the train-pipe admit additional volumes of compressed air as desired. On the further traverse of the piston the main-valve 22 is raised from its seat, opening more widely the main-valve port and admitting a greater volume of air from the valve-chamber to the brake-cylinder. Thus far the operation is identical with the old automatic triple-valve patent No. 220,556. The valve-chamber is, of course, con-

stantly replenished from the auxiliary-reservoir, with which it has free communication.

The new departure in structure which the lower cut exhibits consists in the presence of a partition or stationary diaphragm, 9, which separates the valve-chamber from the piston-chamber, communication between the two, however, being always maintained through the small passage B. This departure may be accurately described as a contraction in the valve-chamber, leaving a free but contracted channel of communication to it from the piston-chamber.

Close attention is now asked to what new thing happens by reason of the presence of this partition or contraction.

In making "service"-stops the devices operate exactly as before, and with the same results, air passing from the valve-chamber to the brake-cylinder through the main-valve port by reason of the movement of the graduating (yellow) valve.

In making "emergency" stops, the piston makes its further traverse as before, the main-valve 22 is unseated as before, and air passes more freely from the valve-chamber to the brake-cylinder, as before. There is no new operation of any sort, certainly *no new operation of the piston*. But auxiliary-reservoir air cannot now *get into* the valve chamber so freely as it did before, because the passage from the auxiliary-reservoir has been *contracted* by partition 9. Still there is no new operation of any part. The effect is that the pressure in the valve-chamber suddenly falls to, say, about five pounds. Consequently the feed-in-valve opens and admits air from the train-pipe to the valve-chamber. This is what this form of feed-valve always did when these conditions existed. There is no new operation here.

The *new* thing that Boyden has done is to cause this old operation of the feed-in-valve, with the old effect of admitting air from the train-pipe to the *valve-chamber*, to take place *at the time he wanted it to take place*; and this he did by a structural change (inserting a partition 9) of a stationary part of the old triple-valve mechanism, which change is not suggested in the Westinghouse auxiliary-valve patent in suit, nor by anything in the prior art. The conception is in the highest degree original, whereas the means or additional members which Westinghouse employed to produce *his* quick-action brake, to wit, the relief-ports, the

auxiliary-valves therefor, and the supplemental-pistons for operating these valves, are *all* found in the prior art. Only the by-passage leading to the brake-cylinder is new, and if the passage in Defendants' brake *through the valve-chamber* corresponds with that, it is anticipated by the Boyden 1883 patent.

The latter patent gives us, by comparison, the exact measure of the new departure in mechanism or means, and in mode of operation, which the invention of Mr. Boyden introduced. In this old patent we find the feed-in-valve in the same position, operating by the same agency (relative fall of pressure in the valve-chamber) to produce the same effect (admission of air from the train-pipe to the valve-chamber). We also find this operation occurring under the same conditions, that is, when the main-valve is open establishing communication between the valve-chamber and the brake-cylinder, and we find the same effect, namely, a passage opened from both train-pipe and auxiliary-reservoir *through the main-valve port*.

There is absolutely no difference, except the great difference of means for *producing at the desired moment* a relatively great fall of pressure *in the valve-chamber*. This difference of pressure did only what it did before, but the means for producing it is new. This new means is the *agency*, by which Boyden obtained—not a new operation or effect—but an *old* operation at a particular time.

Thus the desired result—"quick-action,"—was attained by means, agencies and operations of which such as *did not exist in the art prior to the patent in suit*, were devised by Boyden himself, and were not suggested in the patent in suit, and have no correspondence with the new means or operations described therein.

The process of causing a fall of pressure on one side of the piston (the train-pipe side) to produce A FAR GREATER FALL OF PRESSURE ON THE OPPOSITE SIDE THEREOF, thereby causing the customary operation of the feed-in valve to produce the customary effect, constitutes the essence of the novelty of the Boyden brake, and between it and the novel means and operation of the patent in suit there is no correspondence whatever. On the contrary, while the vital thing in Defendants' brake is the production of much lower pressure in the valve-chamber than in the train-pipe, it is essential in Complainants' brake that the pressure in the valve-chamber should exceed that in the train-pipe; otherwise it will not operate.

This striking difference in essentials emphasizes the fact that the brake of Defendants appropriates *nothing* from the patent in suit.

VALVE 22 NOT THE AUXILIARY-VALVE OF THE PATENT IN SUIT.

One of the contentions of Complainants has been that the small graduating-valve of the Boyden brake is in reality the main-valve, and that the valve 22 is the "auxiliary"-valve. This theory has been so thoroughly handled, and (as we think) disposed of, in former arguments, that we will give it but brief notice. On this *question of fact* both the lower Courts have found against this contention, and we think this Court will not reverse these concurrent findings.*

The argument of Complainants on this point is that valve 22 is not the main-valve of the old triple-valve, but is an "auxiliary"-valve, because, like the auxiliary-valve 41 of Westinghouse, it opens *only for emergency*, and then like the latter it admits train-pipe-air to the brake-cylinder.

The construction of Defendants' brake in respect of the main-valve and graduating-valve is *exactly* that of claim 1 of the old automatic triple-valve patent No. 220,556 (p. 766), as follows :

"1. In combination with the piston and stem of a triple-valve, a valve, H, arranged on said stem, and having a "short range of motion independent of such stem, in combination with an *auxiliary-* (sensitive graduating) valve "*operated by the same stem to close or open a port through the main-valve, without necessarily moving the main-valve,* "*substantially as set forth.*"

This combination is now *public property*

The unanswerable objections to this contention, briefly stated, are :

(1) That the valve 22 does not open *only* for emergency, nor, when it does open, does it admit train-pipe-air *only*. It will open whenever the pressure in the train-pipe is lowered to the proper degree, regardless of whether the pressure is lowered rapidly enough to open the feed-in-valve and admit

* This Court has repeatedly held that it will not reverse the concurrent findings of two inferior Courts on a question of fact unless the error be clear. *Wiscart vs. Dauchy*, 3 Dall., 321; *Lemmers vs. Nissen*, 154 U. S., 650.

train-pipe-air to the valve-chamber. When it does open it is not to admit train-pipe-air, but *any* air that is in the valve-chamber. In *all cases* it admits air from the auxiliary-reservoir. Conspicuously in the case of breakage of the train-pipe it opens *to the fullest extent without admitting any train-pipe-air at all*.

(2) The valve 22 and its subordinate member, the graduating-valve, act exactly as in the old automatic triple-valve patent No. 220,556, the latter opening for service-stops, the former for emergency-stops.

(3) It is obvious from inspection of the drawing of the Boyden brake, and was conclusively shown by trials at the last argument, that *when partition 9 is removed* the device becomes a plain ordinary triple-valve without quick-action, and the valve 22 is *then* beyond dispute the *main-valve*. If so, it remains the main-valve when the partition is inserted.

(4) The "main"-valve is *always* that valve which controls the passage from the *valve-chamber* to the *brake-cylinder*. This valve has nothing to do with admitting air *to the valve-chamber*. The feed-in-valve always attends to that. Therefore, when the main-valve opens it can only do one thing, namely, admit air from the *valve-chamber* to the brake-cylinder. Hence, valve 22 is the main-valve and not an *auxiliary-valve*.

The identification of valve 22 of Defendants' brake as the "auxiliary"-valve is a necessary part of the theory of infringement which Complainants originally attempted to establish, and which is developed by their expert in their *prima facie* proofs. It is on this theory that infringement of claims 1 and 4 was urged. It appears to us that no further discussion of these claims, or of this theory, will be required by the Court. We expect to satisfy the Court not only that claim 2 is not infringed, but that no claim could be based on the invention of the patent sued on that would cover Defendants' quick-action brake.

THE COINCIDENCES BETWEEN DEFENDANTS' QUICK-ACTION BRAKE AND THAT OF THE PATENT IN SUIT
EXTEND ONLY TO FEATURES THAT WERE OLD.

"*Infringement*" consists in the unauthorized use of the NOVEL means described and CLAIMED by the patent sued on. The term "means" does not ignore equivalents, but embraces them, for the equivalent of a thing, in the eye of the law, is "*the same as the thing itself*."*

The conclusion that infringement has not been committed by Defendants in this case follows from the fact, already elucidated, that the essential *new* thing in the brake constructed by the latter, and to which its character as a "quick-action" brake is directly due, is radically different from the *new* features of the patent in suit to which the results it accomplished (which was not "quick-action") were due.

But the examination of the case would not be satisfactory if it did not fully disclose the reasons why, notwithstanding the contrary bearing of the facts, it has been possible to make a respectable showing in support of the contention that infringement has been committed.

We have already shown that this contention has been largely supported by erroneously identifying the discharge of the train-pipe into the *brake-cylinder* as the *cause* of "quick-action," the fact being that the venting of the train-pipe at different points is the *vera causa*, and that the "modification" consisting in connecting these vents with the *brake-cylinders*, though it may have rendered the action of the system as a whole more efficient, was not in any sense the *cause* of "quick-action."

The contention of infringement has been further supported by the fact that between the device of the patent in suit and that of Defendants there are certain coincidences, or points of resemblance. That this fact does not lend the least support to the conclusion urged is fully shown when we have ascertained that the features, in respect of which the two structures resemble each other, were *old*, and that their operation and action have to do with the *ordinary* service of the brake, and not with that *peculiar and special* service which is called "quick-action."

* "Authorities concur that the substantial equivalent of a thing, in the sense of the patent law, is *the same as the thing itself*."

Machine Co. vs. Murphy, 97 U. S. 120.

One method of demonstrating this is to remove from each brake those features to which this peculiar service is due, and to note that *all* the features of *resemblance* between the two remain without change in structure or mode of operation.

Another method is to examine these resemblances in the two structures and to note that they do not reside in the novel features of construction and operation disclosed by the patent in suit. This latter method remains to be applied.

The resemblance to which Complainants' counsel draw the mind of the Court is that in Defendants' brake, as in the patent in suit, the further traverse of the piston preceeds the discharge of the train-pipe into the brake-cylinder, and in both this movement of the piston is one of a train of operations which has for its effect to actuate the means which admit air from the train-pipe to the brake-cylinder. This resemblance admits of use to support the charge of infringement of claim 2, because that claim, as already pointed out, suppresses the air-admitting means and leaves identity to be determined by resemblance in some other particular.

We are therefore to look for identity in the agencies which operate the discharge-valves. If those agencies comprise a series it is manifest that a resemblance in one or more members does not necessarily constitute identity of the series, and that if it be allowable to designate one of these members as *the* actuating device, instead of specifying the entire series, we would be compelled to select that member which is the *primary* agent.

In the present instance this primary agent is plainly the engineer's-valve, and if it be permissible to interpret the patent by this method, claim 2 should clearly read as for the combination with the ordinary automatic brake-mechanism, of an *engineer's-valve* whose "preliminary-traverse admits air from the auxiliary-reservoir to the brake-cylinder, and which by a further traverse admits air directly from the train-pipe to the brake-cylinder." There is as good, or better, justification in the invention for a claim so drawn as for the claim we are discussing, for this is precisely what happens if we indulge the vice (heretofore pointed out in respect of claim 2) of ignoring the proximate or direct cause of the specified effect, and substituting a remote cause. If the claim had been drawn in this way, it would be plainly seen that it was "fatally defective" in not

distinctly pointing out and claiming, as the law requires (section 4888, R. S.), the part, improvement or combination constituting the invention. The reason why the less justifiable designation of the *piston* as the means which admits air from the train-pipe to the brake-cylinder presents a claim in which the vice is more difficult of detection, is simply that a *less remote agent* has been designated as the cause.

Starting, then, with the engineer's-valve, the effect of the specified movements in both the compared cases is, *as in all automatic brakes from the beginning*, to deplete, in different degrees, the pressure in the train-pipe. This then is a point of coincidence between the two series of operations, but it presents nothing new in either. The depletion of pressure, in turn, causes the piston to make either a partial traverse, or a complete traverse, according to the degree of the depletion, and it is this greater or less movement of the piston that claim 2 designates as the agent that admits the train-pipe-air to the brake-cylinder.

These three elements or steps in the operation, to wit (1), the movements of the engineer's-valve, (2) the variation of train-pipe pressure, and (3) the movements of the piston, are common to Complainants' patent to Defendants' structure, *and to the prior art*. We have so far found nothing to distinguish Defendants' mechanism from the mechanism of the patent, *and nothing to distinguish the latter from the prior art*. No new element has yet appeared, nor any step in the operation that has a scintilla of novelty. Selecting the engineer's-valve, or the greater or less depletion of air in the train-pipe produced by the movement of the valve, or the consequent partial and further traverse of the piston, or, taking all three together, would equally fail to specify anything novel in construction and operation. *The novel means for actuating the auxiliary-discharge-valve, described in the patent in suit, lie between the piston and the valve.* The novel means invented and patented by Boyden also lie between the piston and the valve that admits air to the valve-chamber, which in his case was not a new valve. Here, *precisely at the point where the novelty begins, the resemblance ceases*, and this is the reason why no possible interpretation of the patent in suit could be adopted which would embrace what Defendants have done.

In the brake of the patent in suit the piston on its further traverse opens the main-valve and also makes contact with a stem 36, displacing the latter against the pressure of a spring, and this displacement actuates the discharge (auxiliary) valve.

In Defendants' brake the further traverse of the piston opens wide the main-valve, as it did in the prior art, and *it does nothing more*. In the subsequent actions the piston is not an actor or agent. An immediate and great difference in pressure is at once established on opposite sides of the old feed-in-valve. Why? Because the passage from the auxiliary-reservoir to the valve-chamber has been *contracted*, so that the valve-chamber empties through the main-valve faster than it can be replenished from the auxiliary-reservoir. Hence the air from the train-pipe enters the valve-chamber just as it did in the Boyden patent of 1883. But up to this point we have no admission of the train-pipe air to the *brake-cylinder*, we have only *discharged the train-pipe*, using the means of the old art to do it. Entering the valve-chamber the air choses the path leading to the brake-cylinder, rather than that to the auxiliary-reservoir, because it finds the old main-valve open, and the path through it is that of least resistance. So it did, and for the same reason, in the Boyden 1883 patent.

In all this there is not the semblance of utilization of a single element in the means for actuating the auxiliary-valve which was new in the patent in suit.

The conclusion must inevitably be that the brake of Defendants' coincides with that of the auxiliary-valve patent in suit in no feature either of construction or operation that was *new with the latter*. It follows, also, as a corollary, that claim 2 is "fatally defective" if interpreted as excluding the means disclosed in the patent for admitting air from the train-pipe to the brake-cylinder.

A TEST FOR INFRINGEMENT.

If Westinghouse took the old triple-valve mechanism and added something to it, thereby accomplishing quick-action, and Boyden took the same old mechanism, added something to it and thereby accomplished quick-action, the resemblance, to constitute infringement, must be found *in the new or added parts*. Now the novelty in the

parts which Westinghouse added did not reside broadly in a passage or in any "device for admitting air from the train-pipe to the brake-cylinder," which was one thing that he added, for he claimed that in original claim 1 and struck it out in view of Boyden's 1883 patent.

He then limited his claim to a device (auxiliary-valve) for admitting air from train-pipe to brake-cylinder *actuated by the further traverse of piston*. This was his novel addition to the old triple-valve mechanism, so far as the patent in suit (and particularly claim 2 thereof) is concerned.

But that did not produce "quick-action," and so he invented further, and added, by a later patent, a better *actuating motor* for his auxiliary-valve device, leaving the latter unchanged. This improved actuating-motor was the "supplemental"-piston of 376,837.

Boyden, by the addition *he* made to the old structure, produced the same result as that produced by the *two* inventions of Westinghouse. This addition consisted in a partition separating the valve-chamber from the piston-chamber, the partition having a small hole or passage through it.

If then each of these persons has accomplished the *same result* (as is granted), the question remains have they done it *by the same means*?

The answer is that the stationary partition of the Boyden brake is not the same means as the by-passage and auxiliary-valve (of one Westinghouse patent), *plus* the supplemental-piston (of the other Westinghouse patent), because it is not the same in structure or in mode of operation. It is radically different in both respects.

If, however, we found as a fact that the means whereby Boyden produces the result of "quick-action" were the equivalents of the means whereby Westinghouse produced that result, nevertheless *infringement could not be found*, because an essential part of the Westinghouse means is *embraced in a patent not involved in this suit*.

THE REAL INVENTION OF No. 360,070 IN SUIT.

This invention has been put forward by Complainants as the *cause* of "quick-action," *i. e.*, as supplying the means whereby the one thing desired ("*coincidence of application*" of all the brakes) was obtained. We have been largely occupied in showing that the

invention has been presented in a false guise, and necessarily have for the most part ignored the real merit of the invention and the real result it attained.

Had Complainants fairly presented their invention to its best advantage without disguise or false pretenses, it would have appeared in this aspect: that the *result* accomplished by the invention had to do solely with the prompt and forceful *individual* application of the brakes, contributing nothing to the quicker *serial* application thereof, and that the improvement or advantage gained lay in securing the individual application of the brakes in emergency stops without employing a larger auxiliary-reservoir, or a larger passage therefrom to the brake-cylinder, than was required for service stops. This advantage was gained by adding the air discharged from the train pipe in making emergency stops, to that from the reservoir, this formerly wasted air contributing one-sixth of the total pressure. This was the *result* of the invention. The means whereby it was attained consisted of the following modifications of what previously existed: (1) connecting the end of the old discharge-passage of No. 217,838 (the local-vent patent) to the brake cylinder, instead of leading it to the atmosphere; (2) connecting the old discharge-valve with the old stem 36 of No. 220,556 (the old automatic triple-valve) so that the movement of the piston would be communicated to this valve through said stem.

The second modification is of little or no importance. Operating the discharge-valve by the further traverse of the piston had *previously* been done in the arrangement described by Mr. H. H. Westinghouse (p. 124). It is not, by anything that appears in the record, the invention of this patentee, and in any event is excluded from the patent sued on. Moreover, it would appear an obvious expedient, on adding another valve to those ordinarily present in the triple-valve, to connect it with the organ whose customary office is to operate all the valves. Invention would hardly be required until it should appear that the piston was not equal to performing this office for the new valve. *Then* it would become necessary to devise a new motor on account of the refusal of the piston to perform the additional labor of operating another valve. This is exactly what happened, the invention of the "supplemental-piston" of No. 376,837, being achieved at enormous cost and by prodigious effort. Until *its* advent

Westinghouse was as far as ever from quick-action. The field was "as wide open" as in 1886.

By the most liberal view of the invention of the patent in suit, we have in these modifications the basis of the broadest possible claims that could be maintained by the patentee. These modifications present no novelty in *structure* in a broad sense, since a passage from the train-pipe to the brake-cylinder, which opened "simultaneously with the opening of the passage from the auxiliary-reservoir to the brake-cylinder,"* is found in Boyden's 1883 patent. Nor does the qualification that this passage is opened simultaneously with the opening of the main-valve *by the piston of the triple-valve*, confer novelty on the means, because the opening of such passage under such conditions and *by such means* is found in the Boyden 1883 patent and is *expressly disclaimed in the patent in suit*. There remains, then, the qualification of doing this at a particular time, or for a particular purpose, *i. e.* at the time when it is desired to produce a quick stoppage of the train. This qualification itself is not patentable, but the *new* means on which it depends are patentable, and thus we finally arrive at the *means* of the patent, to wit, the auxiliary valve and by-passage, when the valve is combined with the triple-valve piston so as to be mechanically actuated thereby, either directly or through a suitable mechanical connection.†

These means are not anticipated by the Boyden 1883 patent, because, while the final movement of the triple-valve piston therein opens a passage from the train-pipe to the brake-cylinder, thus forestalling any broad claim thereon, it does not do this *by acting upon and unseating an auxiliary-valve*.

For the same reason these new means are not found in Defendants' quick-action brake, wherein there is no by-passage and no auxiliary-

* See disclaimer in patent in suit (p. 726, also inserted folder in this brief).

† H. H. Westinghouse, the brake expert for Complainants, understands the patent in this way. He testifies (p. 153):

"182 X-Q. I will state briefly my understanding of the operation of the valve described in each of the three patents. In patent No. 360,070 the valve which controls communication direct between the train-pipe and the cylinder is opened *by means of the triple-valve piston acting mechanically upon it*; in patent No. 376,837 this valve is opened *by auxiliary-reservoir pressure acting independent of the mechanical action of the triple-valve piston*, and in patent No. 393,784 this valve is opened *by train-pipe pressure acting directly on it*. Is this statement correct?"

"A. So far as the operations described are concerned I regard it as substantially correct."

valve actuated by the piston (or by anything else); but wherein the final movement of the piston uncovers the *same* passage from the train-pipe to the brake-cylinder as in the 1883 Boyden patent, and as disclaimed in the patent in suit.

Had the invention of the patent in suit been thus fairly presented on its proper basis, the foregoing facts would have demonstrated that no possible claim could have been drawn and sustained therein which Defendants would have infringed.

The invention of this patent, to wit, efficiency in securing an old effect by a modification of structure which made it unnecessary to provide, for use in making emergency stops, for more ample power or a larger passage from the auxiliary-reservoir to the brake-cylinder than that employed in ordinary service, is, in the presentation of this case, distorted beyond recognition into a new *process* performed by the triple-valve *piston*, "to produce quick-action."

It is to be noted that, while Westinghouse by the invention of the patent sued on, is enabled to employ a main-valve port of the same size for both service and emergency-stops, this being one of the things he gains by that invention, Defendants, on the other hand, open a *wider* passage through the main-valve port when using the brake for emergency-stops, this being the vital feature of the operation of the brake when so employed.

SUMMARY OF THE ARGUMENT.

We feel justified in drawing the following conclusions from what has preceded:

1. That the patent in suit is not the pioneer patent for the "quick-action brake," but that *per contra* it lacked just what the local-vent patent of 1879 lacked to make it a "quick-action" brake, namely—a quick acting motor.

2. That the patent in suit describes no new process, certainly no new process performed by the piston, and therefore cannot be sustained as to process or method.

3. That Defendants' brake, in so far as it accomplishes any result not accomplished by the brake-mechanisms existing prior to the patent in suit, does it by means not disclosed in said patent; and therefore that no valid claim could have

been based on the invention of the patent in suit which Defendants' structure would infringe.

4. That in Defendants' structure the agency of the piston in establishing communication between the train-pipe and the brake-cylinder is identical with the Boyden 1883 patent, and is in express terms disclaimed in the patent sued on.

5. That the Westinghouse brake, as it existed prior to the patent in suit, lacked one essential thing to give it the characteristic of quick-action, which essential or "indispensable" thing (a quick-action motor) the invention of that patent did not supply, and which is covered by a later patent not involved in this suit.

This brings us to the conclusion of the inquiry which we undertook to conduct. There remain several topics which come properly within the scope of that inquiry, discussion of which we have reserved to this point to avoid interruption of the direct thread of the argument.

MORLEY MACHINE COMPANY VS. LANCASTER,

(129 U. S., PAGE 263.)

Should the Court pass on the question of "pioneership," that question will undoubtedly be examined in connection with this leading case. Therefore a brief reference to the rule as therein stated and applied will be appropriate.

The Court held that Morley was a "pioneer" inventor because he was "the first inventor of an *automatic button-sewing machine*;" that is to say the patent involved *in that suit* disclosed the first machine which successfully did that work.

Having found that to be a *fact*, and that the successful machine comprised as its *essential* elements three sets of mechanisms, to wit, spacing mechanism, feeding mechanism, and sewing mechanism, the Court proceeded to construe the patent as broadly for a *combination* of those three sets of essential mechanisms, the omission of any one of which would have prevented the accomplishment of the result of the invention.

Infringement, under the rule of that case, depended upon finding in the Defendant's machine, not the *result* of the combination, but the *equivalent of each of these essential mechanisms, combined so as to produce that result.*

In the case at bar, granting that Westinghouse was the first inventor of a "quick-action brake," the two things which are "*both essential to the structure of the successful quick-action brake,*" according to the last judgment of the New York Court (quoted with approval by Complainants herein) are (1) the auxiliary-valve of the patent in suit, (2) the "supplemental piston or special motor" of the later patent, No. 376,837. The latter, according to this decision, is *a part that cannot be dispensed with*, and Complainants' counsel quote that finding and insist on its correctness.

Therefore, to apply the rule in *Morley vs. Lancaster*, it is necessary to find in Defendants' structure "the proper equivalent" for this "*indispensable part.*" That decision, after citing and explaining the pertinent decisions of this Court and of English Courts, proceeds to apply the rule deduced therefrom (p. 283):

"Applying these views to the case in hand, Morley having
 "been the *first inventor of an automatic button-sewing machine,**
 "by uniting in one organization mechanism for feeding buttons from a mass, and delivering them one by one to sewing-mechanism, and to the fabric to which they are to be secured, and sewing-mechanism for passing a thread through the eye of the button and securing it to the fabric, and feeding-mechanism for moving the fabric the required distances to space the buttons, another machine is an infringement, in which *such three sets* of mechanism are combined, *provided each mechanism, individually considered, is a proper equivalent for the corresponding mechanism in the Morley patent*; and it makes no difference that in the infringing machine, the button-feeding mechanism is more simple, and the sewing-mechanism, and the mechanism for feeding the fabric are different in mechanical construction, *so long as they perform EACH the same functions as the corresponding*

* By the invention of the patent sued on.

"mechanism in the Morley machine, in substantially the same way, and are combined to produce the same result."

And again—

"In all three of the main mechanisms used in the the Lancaster machine, the means employed in it are substantially equivalents of those employed in the Morley machine."

If, then, we attempt to apply this decision, arguing from the premise that Defendants' accomplish, in their brake, the same result which Westinghouse was the first to accomplish, we must find in the former the proper equivalent for *each* of the essential elements (*indispensable parts*) of the successful Westinghouse brake, performing *"each the same function as the corresponding mechanism in the Westinghouse machine."*

On examination we find in Defendants' brake no proper equivalent for the auxiliary-valve, (for the mechanism contains only the usual valves of the old triple-valve,) operating in substantially the same way; nor any equivalent for the other essential mechanism, the supplemental-piston. The inevitable conclusion is that Boyden has produced the result of "quick-action" by means substantially different. Those means consist of a *contraction* in the passage leading from the auxiliary-reservoir to the valve-chamber.

If, however, we had found that the perforated partition of Defendants' brake *is* the proper equivalent of the auxiliary-valve and of the supplemental-piston, nevertheless infringement could not be found under the rule of Morley vs. Lancaster, because one of these *essential elements* of the Westinghouse machine, which actually produced quick action, is covered by a patent *not involved in this suit*.

RISDON LOCOMOTIVE WORKS VS. MEDART,
(158 U. S. PAGE 68).

If Claim 2 of the patent sued on could be interpreted as for a process of admitting air from the train-pipe to the brake-cylinder by a certain movement of the piston, the question would arise whether, under the settled law of this Court, this operation constitutes a patentable process, as distinguished from the mere functions of mechanical elements.

Such an operation as discharging air, steam, or other agent, may manifestly be a process, as for instance where the agent acts upon a substance "to be transformed and reduced to a different state or thing" (Cochran vs. Deener, 94 U. S. 780). In the process of purifying middlings a current of air was one of the means which (with screening, grinding and rebolting) effected the object of the invention.

Another illustration is furnished by the sand-blast case (Hartell vs. Tillghman, 99 U. S. 547) where a blast of sand impinging upon glass, metal, etc., transformed it to a different state.

Whether the use of compressed air in a machine to exert pressure on a brake could, in any state of the art, be regarded as a process is extremely doubtful. In the air-brake the air acts simply as a mechanical element analogous to a lever, screw, belt or any other mechanical element, to convey power from the air-compressor to the point of application. Compressed air in the air-brake has simply the function of a spring, and in many arts is a well-known substitute for metal springs. But this question requires no discussion, since the process, if any, was old at the date of the patent. Compressed air had been admitted from the train-pipe to the brake-cylinder to perform its usual office there, and this had been done simultaneously with the admission of air thereto from the auxiliary-reservoir. Of novelty, therefore, there remains only the performance of these old operations *by certain specific agents combined in certain specific relations*, to wit, by a valve (governing a passage leading to the desired point) connected with and actuated by the triple-valve piston. The novelty, therefore, resides wholly in a specific arrangement of machine elements, each performing its customary function, and together performing an operation which was old.

The distinction between a patentable process and a function of mechanism, though not always easy to draw, has been recognized from the earliest times.

The famous patent of James Watt, the father of the modern condensing steam engine, provoked a learned discussion on this point in 1795 from the Court of Common Pleas and the King's Bench in *Boulton vs. Bull* (2 H. Bl. 463) and *Horblower vs. Boulton* (8 F. R. 95). The patent specified the invention as a "method" whereof a salient feature consisted in "condensing the steam outside the working cylinders." The construction adopted to save the patent interpreted the inven-

tion as for the *combination* of the cylinders with external condensers. That there was no process or method involved was clearly elucidated by the opinions of the learned judges who were called upon to construe the patent. (See also the great English case, *Nelson vs. Harford*, 1 Webster's patent case.)

The distinction was first clearly drawn by this Court in *Corning vs. Burden* (*supra*), where the patent sued on claimed a process which consisted in treating masses of molten iron between a revolving cylinder and a curved trough, or equivalent devices. In defining a process the Court said :

"It is for the discovery or invention of some practical
 "method or means of producing a beneficial result, or effect,
 "that a patent is granted, and *not for the result or effect itself.*
 "It is when the term process is used to *represent* the means
 "or methods of producing a result that it is patentable, and
 "it will include all methods or means *which are not effected by*
 "*mechanism or mechanical combination.*"

It will not be necessary to follow this doctrine through the cases in which it has been stated and applied in this Court, for the reason that in the recent decision in *Risdon Works vs. Medart* the Court, after quoting at length the definition given by Mr. Justice Grier in *Corning vs. Burden*, said :

"Although the cases are not numerous this distinction
 "*between a process and a function has never been departed from*
 "*by this Court.*"

The decision in the *Medart* case has by some courts and lawyers been regarded as drawing a distinction (not "between a process and a function") but between a process which is of a physical or chemical character, and a process that is of a mechanical character.

To those who observe the recent teachings of science it is not possible to perceive any philosophical distinction between these different manifestations of energy. Science points ever more and more steadily to a common origin for all forms and manifestations of energy. Whether for convenience we speak of a particular manifestation of force as vital, or chemical, or electrical, or mechanical, we recognize that these are, one and all, manifestations, in different aspects, of the same Force which pervades the universe. The patent law must observe the facts of the universe and can create no distinc-

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tion where none exists. It is not necessary, for the purpose of reaching the conclusion we have in view, to strain in the least the doctrine of the Medart case beyond what appears to us to be its clear import. It affirms and emphasizes all the previous decisions of this Court wherein the same question has arisen, establishing firmly that if the invention is a *machine* the patent cannot be sustained as for a *process*, even though the invention be claimed as such.

A fortiori, if the invention be a machine, and be described and claimed as such, the patent cannot be sustained "as to process or method."

ANALYSIS OF PATENT IN SUIT.

(SEE ANNEXED FOLDER.)

In order to lighten the labor of the Court and to make conspicuous the features alleged in the patent specification to be novel; and to show that no reference is made therein to a process or method, but that *per contra* its terms preclude such interpretation, the entire specification has been printed and arranged in three colors in the annexed folder. All the paragraphs and parts thereof in the specification and claims which pertain to *what is new* are colored red, those pertaining to the old prior brake art are black, and that pertaining to the prior art of 1883 is green. A perusal of the specification as far as printed in black will disclose the principal members and operations of the "old automatic brake," upon which the new invention is an improvement. It is sufficient to state that the "old automatic brake" consists of a *main-air pipe*, a *brake-cylinder*, an *auxiliary-reservoir*, and a *triple-valve*, the latter having a piston which has, and had prior to the invention in suit, *two traverses*, one the *preliminary* which was used to operate valves to apply the brake for service stops, and the other, the *further traverse* to operate another valve for emergency stops.

The first red paragraph (A) distinctly states that the invention consists of "*Improvements in Fluid Pressure Brake Mechanism*," not in a *method* or *process*.

The second red paragraph (B) sets forth the object of the invention—rapidity, effectiveness and economy being the *desiderata*. In

this paragraph no method, process or device is described for accomplishing the objects stated.

The third red paragraph (C) refers to an alleged "novel combination of four elements, namely, a brake-pipe; an auxiliary-reservoir; brake-cylinder; and a triple-valve device—all of which are acknowledged later on in the specification (in black) to be old in the art. The "triple-valve" device, however, is characterized as "*governing communications*," not providing the means of communication. Therefore the duty which the "triple-valve" device is to perform in the invention to be disclosed is not doing the work, but in "*governing*" the communications that *are* to do the work. "The improvements *claimed* are hereinafter fully set forth," *i. e.*, the improvements by which the *objects* stated in the preceding paragraph (B), and restated in the following fourth paragraph (D), are accomplished.

The fifth red passage (E) is part of a paragraph in which the patentee refers in general terms (afterwards stated specifically) to the old and new parts of the mechanism. The subject of this paragraph is "the triple-valve 10," which numeral designates on the drawings the entire triple-valve structure including both *old* and *new* parts. It is here stated that this "triple-valve 10" accords substantially with prior patents, and "is not claimed as of my present invention," except as to certain "structural features, by which it performs the further function of effecting the direct admission of air from the main air-pipe to the brake-cylinder." (The word "function" is employed here and elsewhere in this specification as if synonymous with "operation" or "effect.")

Before pointing out specifically what these new "structural features" are, the patentee proceeds to describe at length the *old* parts of the mechanism and their mode of operation. This occupies the the next five paragraphs of the specification, interrupted only by the brief red passage (F). This passage refers only to the minor detail of the small port 35 in the main-valve.

These five paragraphs, printed in black, embrace the description of the *piston*, with its shorter and longer movements (the terms "preliminary" and "further traverses," not being used in the specification), including the action of the piston in displacing, in its final movement, the stem 36. So far from there being a hint of any novelty in the

structure or operation of the piston, this long description of the old parts and their operation concludes with the statement :

"So far as hereinbefore described, the triple-valve accords
"in all substantial particulars with, and is adapted to operate
 "similarly to, those of my letters-patent Nos. 168,359,
 " 172,064, and 220,556."

This passage sharply draws the line in the description between the old parts of the triple-valve 10 and the new or additional parts, which are described in detail in the seventh red passage (G). These new parts, which enable the triple-valve "to perform the further functions requisite in the practice of my present invention" are specified as "certain additional members," to wit, the "auxiliary-valve 41" and the "passage 46."

It is particularly to be noted that, in this detailed description of the construction and operation of the *new* parts there is *no reference at all to the piston*. The auxiliary-valve 41 is described as "connected to" and moving with "the stem 36." There is not the faintest suggestion that the patentee has invented either a new process, or a new piston, or a new operation performed by the piston.

The eighth red passage (H) describes the operation of the additional members (*valve* and *by-passage*) upon a sudden and great reduction of train-pipe pressure, "when the piston of the triple-valve is forced to the extreme limit of its stroke," "carrying with it the stem 36." This describes not a new, but the old operation of the piston, the only novel operation being that of the valve.

The ninth red passage (I) refers further to the action of these additional members. It points out that the discharge of air from train-pipe to brake-cylinder is effected *by the auxiliary-valve and by-passage*—not by the piston—and that the supplemental port 35 of the *main-valve* is opened "*when* the piston 12 arrives at the extremity of its stroke."

The disclaimer, in green, effectually disclaims the Boyden brake of 1883, and also Defendants' quick-action brake, particularly *that office of the piston of the latter which is now pointed to as constituting identity of Defendants' brake with the alleged subject-matter of claim 2*, because the piston in Defendants' brake does nothing more than or different from that which is disclaimed.

In Claims 1 and 4 the new parts, in red, give patentability to the claims. Claim 2 is printed entirely in black, because the combination specified is in its entirety old (and so declared to be in the specification), the only new thing asserted being something alleged to be *done* by the piston, which allegation the entire preceding description contradicts.

From the foregoing we may deduce with great certainty the conclusions :

1. That the invention described pertains to "improvements" in "mechanism" (passage A).
2. That it consists in certain "*structural* features" added to the old parts of the triple-valve, and that save as to these *structural* features nothing in the construction or operation of the triple-valve is "claimed as of the (my) present invention" (passage E).
3. That in structure, function, and mode of operation, the piston is old, and accords with previous patents.
4. That the "structural features," or "additional members" which enable the organization *as a whole* to effect "the direct admission of air from the main air-pipe to the brake-cylinder" are the "auxiliary-valve 41" and "passage 46," (passage G).
5. That the effect, erroneously attributed in claim 2 to the piston, is that of an *organization* composed of many elements, whereof the salient and new elements (auxiliary-valve and by-passage) are not recited in the claim.
6. That no paragraph, sentence or word hints at any new process or method; but, *per contra*, the patentee explicitly says that he claims only certain "*structural* features."

The foregoing conclusions are confirmed by the Patent Office file contents, by the prior art, and the history of the development of the Westinghouse brake, as fully shown in previous parts of the brief.

Respectfully submitted,

LYSANDER HILL,
HECTOR T. FENTON,
MELVILLE CHURCH,
ANTHONY POLLOK,
PHILIP MAURO,

March 7, 1898.

Of Counsel for Defendants.

Addendum in Reply to Brief for Complainants.

The brief filed for Complainants on this third argument invites criticism on every page ; but the only matter which we deem worthy of any reply is the attempt made on page 28 to formulate a construction of Claim 2, which the Court is asked to adopt as the proper interpretation of that claim.

The claim as thus formulated modifies the language of the claim as found in the patent by inserting the words "*by opening a port*" after the words "preliminary traverse," and again after the words "further traverse." We have now another element brought into the claim, to wit, a "port," or, rather, "two ports," and are afforded thereby a clear recognition on the part of Complainants' counsel of the existence of what we have herein referred to (see p. 35) as the vice in Claim 2. They recognize that the claim is defective in not specifying the means which produce the effect, but reciting instead a device which merely conveys power to those means ; and they here attempt to obscure this defect by introducing an element (port) which may produce an appearance of conformity to the statute without sacrificing that indistinctness which alone makes the claim valuable to Complainants. If the Court recognizes the principle to which we have called attention they will have no difficulty in seeing that its application requires the presence in the claim of an auxiliary-valve and by-passage, or the equivalents thereof. The "port" does not produce the described effect any more than does the piston ; nor does the piston open a port.

But there is no justification for this formula ; on the contrary all the pertinent facts preclude its adoption. The specification does not ascribe the specified effect to a "port," but to an additional valve and by-passage. Every claim of the patent, including Claim 2, as interpreted to the Patent Office by the attorney who drew it, specifies these elements as the means which produce the described effect.

The charge of infringement which defendants were called upon to meet was based on the alleged use of an "auxiliary-valve" (additional to the usual valves of the brake-mechanism), controlling a passage from the train-pipe to the brake-cylinder. That charge has been met, and has been disposed of by both the lower courts. It falls when the conclusion is reached that valve 22 of Defendants' brake is not Complainants' "auxiliary" valve. The effort now is to find an interpretation of Claim 2 that will ignore its character as a combination claim and embrace means substantially different from those which the patent discloses for producing the described effect. This is not possible unless it can be construed and sustained as for a process, which our opponents concede cannot be done.

On the other hand we submit that Claim 2 can be sustained only by construing it as for a combination including with its recited elements (not a "port") but an auxiliary-valve and conduit controlled thereby and leading from the train-pipe to the brake-cylinder.

This interpretation is that of the solicitor who prepared it, is that upon which the Patent Office granted it, is that of the specification, and is supported by Complainants' *prima facie* proofs.

Nos. 99 and 116.

Supreme Court of the United States.

FILED.

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JAMES H. MCKENNEY,

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October Term, 1897. Nos. 99 and 116.

Brief of Hill for Boyden & Co.

BOYDEN POWER BRAKE COMPANY

GEORGE A. BOYDEN, President.

CHARLES B. MANN, Secretary.

WILLIAM WHITRIDGE, Treasurer.

AND
BOYDEN BRAKE COMPANY,

Appellants.

APPEAL.

VS.

GEORGE WESTINGHOUSE, JR.

AND

THE WESTINGHOUSE AIR-BRAKE CO.

Appellees.

GEORGE WESTINGHOUSE, JR.,

AND

THE WESTINGHOUSE AIR-BRAKE CO.,

Appellants.

VS.

BOYDEN POWER BRAKE COMPANY.

GEORGE A. BOYDEN, President.

CHARLES B. MANN, Secretary.

WILLIAM WHITRIDGE, Treasurer.

AND

BOYDEN BRAKE COMPANY,

Appellees.

CROSS-APPEAL.

THIRD ARGUMENT.

ADDITIONAL BRIEF FOR BOYDEN BRAKE CO.

LYSANDER HILL,

Of Counsel for Defendants.

IN THE
Supreme Court of the United States.

OCTOBER TERM, 1897.

No. 99.

BOYDEN POWER BRAKE COMPANY ET AL.,
Appellants,

vs.

GEORGE WESTINGHOUSE, JR.,
AND THE
WESTINGHOUSE AIR BRAKE COMPANY,

No. 116.

GEORGE WESTINGHOUSE, JR.,
AND THE
WESTINGHOUSE AIR BRAKE COMPANY,
Appellants,

vs.

BOYDEN POWER BRAKE COMPANY ET AL.

Can Claim 2 be Construed as for a Process?

This question involves two inquiries, viz: (1.) Even if the thing described in the specification involved a patentable process, can *this patent* be construed to cover it? and, (2.) Does the invention involve a patentable process?

We will consider these two subjects in their order :

I.

Does the Patent Describe or Claim a Process ?

The claim is in terms, for a mechanical combination. To construe such a claim as for a method or process is to do violence to its language. The settled rule of law is that the words of a patent, like those of any other contract, must be construed in their plain, ordinary, and usual signification ; and this rule will be clearly disregarded if this claim be construed as for a process or method.

This rule is never disregarded unless there exists some paramount necessity for so doing. The necessity exists only when it is clear that the words, if taken in their plain, ordinary, and usual signification, will fail to express the meaning intended by the parties. The intended meaning must be shown by the document itself, or, in case of a latent ambiguity, must be proved by other evidence ; in no case can it be derived merely from guess-work on the part of the Court.

The question then arises whether Westinghouse *intended* to take out a patent for a method or process instead of one for a mechanical combination, and whether the Government understood him as applying for a process or method patent and intended to grant him such a patent.

The patent and the application proceedings clearly negative any such theory, because the language found therein, both of himself and of his patent solicitor, Mr. J. Snowden Bell, is in irreconcilable conflict with any such theory. *That language could not have been used, and it never would have*

entered their minds to use it if they had had the idea that they were taking out a method or process patent.

(a) It is inconceivable that if they were intending to procure a method or process patent they could have drafted and filed a specification of more than five hundred and fifty printed lines in length without once even mentioning the word "method" or "process," or hinting that this was what they were trying to protect.

(b.) Mr. Bell, who drew the specification and claims, was an experienced and competent patent lawyer and solicitor—so competent that, in this suit, he was entrusted with the responsible duty of taking all the testimony on behalf of the complainants and of cross-examining the defendants' witnesses. He knew, as well as he knew his own name, that in all the great process cases—the chilled car-wheel, the Goodyear rubber, the driven-well, the torpedoing of oil-wells, the sand-blast, the fat-acid, the beer fermentation, the nickel-plating, the telephone, the Cochrane flour purifier, and other similar cases—the claim which was sustained for a process or method was, in express terms, *a claim for a process or method*, and that there is not a case on record where a claim, in terms for a mechanical combination, had been construed as for a process or method. If he had desired to secure a claim for a process or method and other claims for mechanical combinations, the Bell Telephone case taught him that the proper form of claim was: "The method of and apparatus for" accomplishing the desired result. It is simply inconceivable that such a lawyer could, while intending to patent a process or method, have drawn and filed a specification and claims which do not even hint at such an intention.

(c.) Mr. Westinghouse was not an ignorant "backwoodsman," unfamiliar with the meaning of terms used in mechanics and in patents, but an intelligent and able man,

of great experience in these matters, to the study of which his whole life had been largely devoted. His success in business shows that he is also a man accustomed to look closely after his own interests and to claim the full benefit of his legal rights. He knew the practical difference between a "process" or "method" and a "mechanism" or a mechanical "combination," as well perhaps as it is known to any member of this court.

(d.) It is absolutely inconceivable that, with the intention of patenting a method or process, either Mr. Bell or Mr. Westinghouse would have prepared and filed a specification which begins with these words: "Be it known that I, George Westinghouse, Jr., residing at Pittsburg, in the county of Alleghany and State of Pennsylvania, a citizen of the United States, have invented or discovered certain new and useful improvements in Fluid-Pressure Automatic Brake *Mechanism*, of which improvements the following is a specification." Here, there was sharply presented to their minds the very question of what the invention consisted in, and what they were going to describe and cover in their specification and claims; and they decided that it was not a method or process, but an improvement in the mechanism.

(e.) A few lines further on the same question was again sharply presented to their minds, and, at lines 20-27 of the specification, they declared that the invention "*consists in a novel combination*" of certain mechanical elements which they proceed to mention.

How is it *possible* that they could have made these declarations if they had understood that the invention consists in a new process or method and not in a new mechanical combination or mechanism?

(f.) Again, in claim 2, Mr. Westinghouse says, with the evident approval of Mr. Bell: "I claim as my invention and desire to secure by Letters Patent. * * * *In a brake*

mechanism, the *combination* of a main air-pipe, an auxiliary reservoir, a brake cylinder and a triple-valve," etc. Here, the claim is expressly limited, first, to a "mechanism," and secondly to a specific "combination" contained in that mechanism.

(g.) Finally as if to clinch the matter and leave nothing for future controversy, Mr. Westinghouse, in lines 41-46 of page 2 of his specification, expressly declared that he *did not claim* the triple-valve, "saving as to the *structural features by which it performs* the further function of effecting the direct admission of air from the main air-pipe to the brake-cylinder, as presently to be described."

It is seen, therefore, that the patent contains four emphatic declarations on the very point here in question, all concurring that the invention is an improvement in the mechanism, and not a word to show that either Mr. Westinghouse or his solicitor had the slightest idea that they were going to patent a method or process.

(h.) Two months after filing said specification, Mr. Bell, (January 19, 1887,) in his letter to the Commissioner of Patents again declared their intention to patent, not a process or method, but a mechanism, saying that "*When, however, the triple-valve is provided with an auxiliary-valve operated by its piston, which performs a new function additional to that of the triple-valve as previously employed, it is believed that such combination is wholly novel.*"

(i.) Moreover, throughout the entire specification, whenever Mr. Westinghouse or his solicitor had occasion to speak of the new work which the new mechanism performs, they do not refer to it as in the nature of a new method or process, but expressly as merely *a function of the new mechanism*. Thus, at page 2, lines 42 and 43, the patentee calls it "the further *function* of effecting the direct

admission of air from the main air-pipe to the brake-cylinder," and, at page 3, lines 44 and 45, he calls it "the further *functions* requisite in the practice of my present invention," while Mr. Bell, in his letter to the Commissioner, also calls it "a new *function* additional to that of the triple-valve as previously employed." The new work accomplished by the new mechanism addressed itself to their minds, not as a new method or process, but merely as a function of the mechanism described. If there was a new method or process involved, they evidently did not know it. To their minds, everything connected with the invention was mechanism, and its work was the mere function of mechanism. Nor is there any evidence that the Patent Office officials took any view of the matter different from that of Mr. Westinghouse and his solicitor. On the contrary, the fact that the Examiner refused to allow claim 2 until after Mr. Bell had, by his letter of January 19, 1887, declared that he was not seeking a broad claim, but only a claim for a specific combination containing the auxiliary valve as an element, shows clearly that the Examiner had no intention of granting a process claim.

Therefore, to construe claim 2 as for a method or process would be to do violence to its plain language, *not for the purpose of promoting, but of defeating*, the clearly expressed intention of the parties to the contract. Such a decision would overthrow the precedents, of a century and reduce the law relating to the construction of contracts and other documents to a state of absolute confusion.

Moreover, this court has repeatedly held, in the reissue cases arising since *Miller vs. The Bridgeport Brass Co.*, 104 U. S., 350 that in construing the claim of a patent the patentee is bound by his original intention to take a restricted claim,

and is estopped from subsequently attempting to enlarge such a claim. He can be relieved only in cases where there was some inadvertent error in the description, or where he intended to make a broad claim and by inadvertence, accident or mistake made a narrow one—and this, clearly, for the purpose of effecting, not of defeating, his original intention.

The fact that the clear language of a claim renders it narrower than the invention actually made by the patentee does not authorize the courts to construe its words other wise than in their plain, ordinary and usual signification.

“Where a claim is so explicit the courts cannot alter or enlarge it. * * * But the courts have not the right to enlarge a patent beyond the scope of its claim as allowed by the Patent Office, or the appellate tribunal to which contested applications are referred. When the terms of a claim in a patent are clear and distinct (as they always should be,) the patentee, in a suit brought upon the patent, is bound by it. (*Merrill vs. Youmans*, 94 U. S., 568.) He can claim nothing beyond it. * * * As patents are procured *ex parte*, the public is not bound by them, but the patentees are. And the latter cannot show that their invention is broader than the terms of their claim, or, if broader, they must be held to have surrendered the surplus to the public.”

Keystone Bridge Co. v. Phoenix Iron Co., 95
U. S., 274, 278-9.

Again, the proposed construction would make for Mr. Westinghouse a new patent, for a different invention; for this Court has repeatedly held that a process and a machine are not the same invention, and that for this reason, if no

other, a patent for a machine cannot be reissued for a process. (*Eachus vs. Broomall*, 115 U. S., 429; *Heald vs. Rice*, 104 U. S., 737, 753; *James vs. Campbell*, 104 U. S., 356, 376-7; *Wing vs. Anthony*, 106 U. S., 142).

Among the decisions of this Court, several cases are reported in which a claim, in terms for mechanism, was sought to be construed as a claim for a method or process; but in every instance the Court held the contrary. In some of these cases the patentee's right to cover a method or process was much clearer than in the case at bar. For example, in *Leroy vs. Tatham*, 14 How., 156, there was no doubt that the Hansons had discovered a property of metallic lead before unknown; and their invention utilized this property for an important industrial purpose. But their claim was for "the combination of the following parts above described, to wit, the core and bridge or guide-piece, the chamber, and the die, when used to form pipes of metal, under heat and pressure, in the manner set forth, or in any other manner substantially the same." The Court, speaking through Mr. Justice McLean, said :

"The patentees have founded their claim on this specification, and they can neither modify nor abandon it in whole or in part. The combination of the machinery is claimed, through which the new property of lead was developed, as a part of the process in the structure of the pipes. But the jury were instructed, 'that the originality of the invention did not consist in the novelty of the machinery, but in bringing a newly discovered principle into practical application.' The patentees claimed the combination of the machinery as their invention in part, and no such claim can be sustained without establishing its novelty— not as to the parts of which it is composed, but

as to the combination: *The question, whether the newly developed property of lead, used in the formation of pipes, might have been patented, if claimed as developed, without the invention of machinery, was not in the case. * * **

"We think there was error in the above instructions, that the novelty of the combination of the machinery, specifically claimed by the patentees as their invention, was not a material fact for the jury, and that on that ground the judgement must be reversed."

In *Crescent Brewing Co. vs. Gottfried*, 128 U. S. 158, 166, the claim was for "The application of heated air under blast to the interior of casks by means substantially as described, and for the purposes set forth;" and the court said that the claim "is a claim to the means or apparatus described for applying the heated air under blast to the interior of the casks, and is a claim for mechanism and not for a process."

In *Grier vs. Wilt*, 120 U. S. 412, 428, the claim was, in terms for mechanism. The complainant contended (see pages 425, 426): "That the patentee is the originator *"of an idea*, which is a novel and useful one, of raising the stack of trays from a point on the lowermost tray of the stack, thus making an opening for the insertion of a fresh tray containing fruit, and in this manner building the stack up from the bottom instead of from the top; * * * the object and value of the patent consisting not in the use of any special machinery for elevating the stack for the purpose intended, but the elevation and opening of the said stack at the bottom, for those purposes, by any machinery best calculated to attain that end." The Circuit Court adopted this view; but the Supreme Court held the contrary and reversed the decision below, saying (page 428) "*This is the effect or result of the mode of operation of the devices. The claim, however, is not for a process, but is only for mechanism.*"

In *Weatherhead vs. Coupe*, 147 U. S. 322, 333, the first claim was for mechanism, and the third claim for a method, but this court held that the method consisted, in substance, in using the mechanism specified in the first claim, and therefore could not be infringed otherwise than by infringing the first claim—in other words, that the third claim, notwithstanding its form, was substantially a claim for mechanism. The Court did not advert to the question whether the third claim was void for claiming merely the function of the mechanism specified in the first claim, but contended itself with saying, in substance, that as the defendant did not use the same mechanism, he did not infringe the patent.

In *Dreyfoos vs. Wiese*, 124 U. S., 32, 36, the claim was for mechanism, the operation of which was to impart a circular direction to the feed-motion by feeding faster at one end than at the other. It was contended for the plaintiff that as Beck was the first to devise a combination, the gist of which was to feed faster at one end than at the other, he was entitled to cover all variations in the form of the feed, so long as by any means it operates in this way; and that if that result is accomplished, the mechanism must be an equivalent for that of the plaintiff.

Both the Court below and this Court held that the patent *must be limited to the mechanism described and claimed*, and could not be extended so as to cover all mechanism for giving a circular direction to the feed-motion, nor to the process of operation of the mechanism described in the patent; and that the defendant, who used a different mechanical means for getting the same result, did not infringe.

In *Yale Lock Co. vs. Sargent*, 117 U. S., 373 (cited in the case last mentioned), the object of the invention was to obtain the variable action of two rollers with respect to the cam by which they were operated. The patentee, who

seems to have been the first in the art to utilize this principle, accomplished the result by using rollers of different eccentricity, and claimed rollers of varying eccentricity when combined with the cam. The defendant used rollers of equal eccentricity, and varied their action with respect to the cam by other means. It was contended that the patentee was entitled to cover the new and useful result which his mechanism produced; but this Court, reversing the decision below, held the contrary.

In *Burt vs. Evory*, 133 U. S., 349, the specification stated that the invention consisted in a *mode of constructing* a shoe, but ended by claiming a *shoe* having certain peculiarities of construction. The Court held that the patent was for a shoe, and not for a method; and laid stress upon the fact that the patentee's counsel, in his brief, had admitted such to be the fact.

Many other cases may be cited to the same effect, and, so far as we know, none to the contrary. The general principle of them all is, that no matter what may be the invention of the patentee, if he has limited his claim to a mechanism it must be construed as for a mechanism and cannot be enlarged to include a process or method.

II.

Does the Invention Involve a Patentable Process?

This brings us to the question: What is a patentable process?

A process may be patentable irrespective of the particular form of the instrumentalities used, (*Cochrane vs. Deener*, 94 U. S., 780, 787; *The Telephone Cases*, 126 U. S., 533); but where mechanism of a certain character is necessarily

used in carrying out the process, the process may be construed as involving such mechanism. (Lawther vs. Hamilton, 124 U. S., 1; LeRoy vs. Tatham, *supra*; Tilghman vs. Procter, 102 U. S., 707.)

"A process is a mode of treatment of certain materials to produce a given result. It is an act, or a series of acts, performed upon the subject-matter to be transformed and reduced to a different state or thing. If new and useful, it is just as patentable as is a piece of machinery. In the language of the patent law, it is an art. The machinery pointed out as suitable to perform the process may or may not be new or patentable; whilst the process itself may be altogether new, and produce an entirely new result. The process requires that certain things should be done with certain substances, and in a certain order; but the tools to be used in doing this may be of secondary consequence." (Cochrane vs. Deener, 94 U. S., 780, 788.) "It may be said, in general, that processes of manufacture which involve chemical or other similar elemental action are patentable, though mechanism may be necessary in the application or carrying out of such process, while those which consist only in the operation of a machine are not." (Risdon Locomotive Works vs. Medart, 158 U. S., 68, 72.) A process may include the entire series of steps employed in the production of a certain article, or it may, as in Fermentation Co. vs. Maus, 122 U. S., 413, involve but a single step in the series. If it consists merely in a series of manual or mechanical operations, involving only the skill or judgment of the experienced workman, it lacks invention, and for that reason is not patentable. And if, in these manual or mechanical operations, the workman uses improved tools or machinery, the protection, if obtained at all, must be obtained through patents on the new or improved tools or machinery. (Risdon Locomotive Works vs. Medart, *supra*.)

Where a process being new and involving a discovery, or the exercise of invention produces a useful *product*, new or old, or an improvement in a useful product, there is no doubt as to its patentability under our laws. In England it was for a long time held that in such cases the invention consisted in the product as a vendible commodity, and that the process of manufacture was not patentable; but for the past fifty years it has been held there as here, that, in such cases, the process of manufacture itself is patentable. Such a process is, in substance, an improvement in the *art of manufacturing* the useful product. In such sense the telephone process was an improvement on the art of producing, at a distance, a copy or copies of the words or sounds uttered in the neighborhood of the transmitting instrument; the driven-well process was an improvement in the art of constructing wells; the Cochrane purifier process was an improvement in the art of manufacturing flour; the Tilghman process, an improvement in the art of manufacturing fat acids; the Hanson process, an improvement in the art of manufacturing lead-pipe; the Neilson process, an improvement in the art of manufacturing iron; the Meller & Hoffman process, an improvement in the art of manufacturing beer, &c., &c. This court, in *Risdon Locomotive Works vs. Medart*, (158 U. S. 68, 77), said of these processes: "It will be observed that, in all these cases, the process was either a chemical one, or consisted in the use of one of the agencies of nature for a practical purpose." The Court might have said, with equal force, that in all of them the process was concerned in the production of some useful article or thing, either in the nature of a vendible commodity, or, as in the telephone production of sound-copies at a distance, something closely akin thereto—there was something which, in the language of *Cochrane vs. Deener*, was to be transformed and reduced to a different state or thing, by an act or a

series of acts. Even a preserving process may justly be regarded as but the last step of a series whose object is to produce the food of other article in a condition suitable for transportation or subsequent use. It is doubtful whether, under the laws of England or America, a process is patentable unless it is concerned in the production of a substantial product. In not a single case that we can call to mind has the Court ever sustained a process patent for an improvement in a *mechanism*, whereby merely its quickness of operation or power of action was promoted-improvements of this character having always been left to the protection afforded by mechanical patents. It would be a radical innovation, leading, no man knows whither, if the field of process patents were now enlarged to include these mere mechanical results.

The Courts have never given a terse and exact definition of a patentable process. Perhaps it cannot be done. In the *Medart* case, this Court, speaking through Mr. Justice Brown, said: "That certain processes of manufacture are patentable is as clear as that certain others are not, but nowhere is the distinction between them accurately defined. There is somewhat of the same obscurity in the line of demarkation as in that between mechanical skill and invention or in that between a new article of manufacture, which is universally held to be patentable, and the function of a machine, which it is equally clear is not. It may be said in general that processes of manufacture which involve chemical or other similar elemental action are patentable, though mechanism may be necessary in the application or carrying out of such process, *while those which consist solely in the operation of a machine are not*. By "elemental action" we understand the Court here to mean to exclude the mere mechanical action of the elements. With this understanding, perhaps a definition can be approxi-

mated by combining together the statements of the Medart, Cochrane and Burden cases, substantially as follows, viz.:

"A patentable process is a process of manufacture consisting in an act or series of acts involving chemical or other similar elemental action, by which a substance or article is transformed and reduced to a different state or thing."

Whether this definition be satisfactory or not it is certain, as above stated, that neither in England nor America have the courts ever sustained a process patent for an improvement in mechanism, whereby merely its quickness of operation or power of action was promoted. In all such cases the increase of quickness or power is a *mechanical result*, necessarily due to some physical change in the organization of the machine; and the *invention* consists in the devising of the change of organization which causes the new or improved result. The change of physical organization has brought into existence a new mechanical combination, or possibly a group of them. This new combination acts differently from the old, *because* it contains some mechanical element absent from the old, or some new arrangement or adjustment of the old elements, producing either a new kind of co-action among the several elements composing the combination or else an additional action not produced by the combination before. At all events there is a *new action*; and, in *Blake vs. San Francisco*, 113 U. S., 679, 688, this Court held that it must be new *in kind*, in order to confer patentability. The peculiar new action, in the combination, of the new element, adjustment or arrangement, is, of course, necessarily caused by a new mode of operation of the combined elements, and it is this new mode of operation that enables the desired result to be effected.

In *Winans vs. Denmead*, 15 How. 330, 341, this Court held that "the patentee may, and should, so frame his specification of claim as to cover this new mode of operation which

he has invented ;” but in the later case of *Burr vs. Duryee*, 1 Wall., 531, the same Court said (page 570) that the patent law gives “*no authority to grant a patent for a ‘principle’ or a ‘mode of operation,’ or an idea, or any other abstraction ;*” that (page 571 :) “All others have an equal right to make improved machines, provided they do not embody the same, or substantially the same *devices, or combination of devices*, which constitute the peculiar characteristic of the previous invention;” that (page 572) the argument : “That two machines produce the same effect will not justify the assertion that they are substantially the same, or that the devices used by one are, therefore, mere equivalents for those of the other;” and (page 573) that “*This is a flagrant abuse of the term ‘equivalent.’*”

From these two cases, taken together, it follows conclusively that he who would cover a new “principle” or “mode of operation” in a machine, must first ascertain what new mechanical peculiarity of the machine in question it is that is necessary to the new mode of operation, and must claim such new mechanical peculiarity—in other words, he must claim the new device or mechanical means which produces the new mode of operation.

It was in this sense that the Supreme Court said in *O’Reilly vs. Morse*, 15 How. 62, 119 :

“Whoever discovers that a certain useful result will be produced in any art, machine, manufacture, or composition of matter, by the use of certain means, is entitled to a patent for it ; provided he specifies the means he uses in a manner so full and exact that anyone skilled in the science to which it appertains can, by using the means he specifies, without any addition to or subtraction from them, produce precisely the result he describes. And if this cannot be done by the means he describes the patent is void. And if it can be done, then the patent confers on him the exclusive right to

use the means he specifies to produce the result or effect he describes *and nothing more*. And it makes no difference in this respect whether the effect is produced by chemical agency or combination, or by the application of discoveries or principles in natural philosophy known or unknown before his invention; or by machinery acting altogether upon mechanical principles. In either case he must describe the manner and process as above mentioned, and the end it accomplishes. And anyone may lawfully accomplish the same end without infringing the patent, if he uses *means* substantially different from those described."

In the *Telephone Cases*, 126 U. S., 533, this Court discriminated sharply between a "discovery" and an "invention," saying:

"In doing this, both discovery and invention, in the popular sense of those terms, were involved; discovery in *finding the art*, and invention in *devising the means* of making it useful. For such discoveries and such inventions the law has given the discoverer and inventor the right to a patent—as discoverer, for the *useful art, process, method* of doing a thing he has found; and *as inventor, for the means he has devised* to make his discovery one of actual value."

So, also, *Corning vs. Burden*, 15 How., 266, 268.

III.

Application of These Principles.

In the light of these principles let us now consider the Westinghouse invention in controversy.

(a.) The first thing which arrests our attention is that the apparatus is not concerned with any manufacturing operation whatever—it is a mere device for applying power to arrest the movement of a railway car.

(b.) We also observe, in the same connection, that the invention in controversy is for the mere purpose of quickening the action of the machine when the engineer may desire so to do.

It may, therefore, be remarked at the outset that it is doubtful whether such an apparatus can, under any circumstances, be the legitimate subject of a patent for a process.

(c.) Pursuing our examination, we observe that the apparatus, generically considered, is not new—it is only an improvement upon prior automatic air-brakes. Its motive power is contained in compressed air, supplied by a pump on the locomotive, and stored up along the train in pipes and reservoirs, ready for use. This motive power is applied, as in the older automatic air-brakes, by admitting it from its storage connections to the brake-cylinder, where its expansive force moves the brake-piston. There is nothing new, therefore, in the power itself, or in the way in which, or subject upon which, it operates. It is the same old power, having the same old mode of operation. There was no new *discovery* involved; for the force of compressed air had been known and used, in various arts, for hundreds of years. If the action of artificially-compressed air could, by any stretch of language, be called “elemental,” in the sense in which that term is used in the *Medart* case, still there is nothing new about it; it is the same old element, producing its result by the same old capacity for expansion. Even if the patent at bar were the first in which the expansibility of compressed air had been utilized for a mechanical purpose, such use could not be monopolized by a patent any more than could the expansibility of compressed steam for driving boats or impelling machinery. (See *O'Reilly vs. Morse*, 15 How. page 115). The invention, therefore, is not in the nature of a “discovery,” nor does it involve any chemical action or any new “elemental” action or effect

whatever. It is simply a *machine*, which, through the presence of a new valve and air-passage, can, when the engineer desires, be made to operate more quickly than it did before such new valve and air-passage were added. A patent for the new valve and air-passage will, therefore, cover all the invention that was made.

The broad idea of producing quick action by the local venting of the train-pipe at each car, cannot be claimed in this patent, because it is the very gist of the invention set forth in the expired patent, No. 217,838, dated July 22, 1879, where Mr. Westinghouse said :

"It sometimes happens with such brake-apparatus, especially in case of accident" (emergency), "that material advantage could be effected by having *all the brakes of the train applied or brought into action simultaneously, or as nearly so as possible*. To accomplish this it is only necessary to make provision for the simultaneous opening of one or more ports in the air-conduit passage *at points not remote from each auxiliary-reservoir*. For this purpose I arrange at such various parts of the air-conduit *or communicating pipes* as may be desired, but by preference at the couplings, relief-valves of the kind shown in the drawings."

All that Westinghouse did, in patent 360,070, was to change the *form* of these relief-valves and operate them by the impact of the triple-valve piston. He simply combined the two old devices, the relief-valve and the triple-valve, adding the former to the latter and calling it his auxiliary-valve 41. It was probably a perception of this fact that caused his counsel to characterize the invention of patent No. 360,070 as a combination of *two machines*. Granting that he got a better effect, *there was no new process*, although there was a new mechanical combination. Boyden adds no relief-valve; he has discovered how to make the old triple-valve do the work without a special relief-valve.

- It is barely possible that the finding out in 1879 that by locally venting the train-pipe or its "*communicating pipes*" under each car throughout the train the serial action of the brakes would be quickened, or rendered simultaneous, "or as nearly so as possible," might be regarded as a "*discovery*," in accordance with the ruling of this Court in the Telephone Cases, 126 U. S., 533, entitling its finder to take out a patent for an art, process, or method. It involves, so far as can be seen, the only thing in the nature of a "discovery" that has ever emanated from Mr. Westinghouse in the brake-art. It either was a "discovery," in the sense of the patent law, or it was not. If it *was*, then the element of "discovery" was exhausted in 1879, and nothing remained to be done in 1886 except to "invent" an improvement in the means for applying the old discovery; if it was *not*, then, assuredly his subsequent application of the same principle by his combination of the old relief-valve with the old triple valve cannot amount to a "discovery." Courts must be logical and consistent in their reasoning. The stream cannot rise higher than the fountain; and if the original discovery and generic embodiment of the principle did not amount to a technical "discovery," surely the mere reapplication of that principle in an improved machine cannot.

(d.) More closely analyzing the new machine, we find it to consist of two parts, or two machines, combined together. Counsel for Westinghouse, in their brief in the Circuit Court of Appeals at Richmond, correctly described it as follows:

After referring to the old triple-valve of the prior art, they said:

"Westinghouse added to and combined with this brake *another brake mechanism*, which, on account of its novel predominant characteristic or function, had given to the whole apparatus its own name of *quick-action* or *emergency* brake,

both names being used. And he so combined these two mechanisms 'the service' and the 'quick-action' that while, in fact, they constitute two machines, they are also included in a *single structure*, and are put into a co-acting or operating mechanical relation with each other, as will presently appear."

The learned counsel saw in the device a "characteristic or *function*" which gives it its name, and the mechanical combination of two machines by which the *function* is effected; but they evidently saw nothing in the nature of a new process. To them, the invention appeared just as we have shown his attorney that it appeared to Mr. Westinghouse and Mr. Bell when they took out the patent in suit.

(c.) Considering, now, the "two machines," viz.: (1) the old plain triple-valve, and (2) the new auxiliary valve and by-passage, we find at once that the first, the old plain triple-valve, acts exactly as it always did—the patent expressly declares this to be true. The triple-valve piston actuates a valve which admits some of the compressed air to the brake-cylinder, just as in the old device. It, therefore, involves no new process or method. Turning next, to the second machine, the auxiliary valve and by-passage, we find the process or method the same as in the other—the piston actuating a valve which admits some of the compressed air to the brake-cylinder. In this instance, the valve admits air directly from the train-pipe to the brake-cylinder; but the admission of compressed air directly from the train-pipe to the brake-cylinder was old, being found in the Boyden patent of June 26, 1883, in all the air-brakes prior to the automatic, and in the automatic air-brake of the Westinghouse patent, 168,359, where it is claimed in claims 7 and 8. Still no new process or method, even in the baldest mechanical sense. Considering, lastly, the combination of the "two machines," we find

that the piston on its half-stroke, operates the one, and, on its full-stroke, both; and that this is the only peculiarity that appears in the combination. *But this is purely mechanical*, due to the peculiar arrangement of the valves, and possessing not a single characteristic of a patentable process or method. There is no "discovery," or "chemical" action, or "elemental" action about it, nor does it take part in producing any product. It is merely the "function" of the described mechanism; and if this is to be regarded as a patentable process or method, then scores of old decisions will have to be overruled, and the patent-law reconstructed on lines before unknown.

The claim requires no such ruling. As we have already remarked, it is, in terms, a claim for a mechanical combination of four old elements, one of which is a triple-valve having a piston. The claim states that this piston on its preliminary traverse admits reservoir air to the brake-cylinder, and on its further traverse admits train-pipe air to the brake-cylinder, but this statement is incorrect—the piston admits no air; it only actuates certain valves, and the valves admit the air. It is also incorrect in implying that the reservoir-air is admitted to the brake-cylinder only on the preliminary traverse; whereas, in fact, it is admitted both on the preliminary and the further traverse—on the preliminary traverse, by the graduating-valve, and on the further traverse, by the main valve. The distinction which the claim points out between the old and the new mechanism is, that the former, on both traverses, admitted only reservoir air, whereas the latter, on its final traverse, also admits train-pipe air—in other words, that, if the two combined machines contained in the new mechanism, (1, the old triple-valve, and 2, the auxiliary-valve 41 and its by-passage) the piston, on its half-stroke, operates the one, and on its full stroke, both. Here, then, is a claim for a *piston*

which consecutively actuates two valves controlling, respectively, two different passages; and the question is whether such a claim is for a mechanical device or for a process.

How can there be any *question* about it? It is purely a mechanical operation, dependent upon the construction and arrangement of the valves and their passages. Given, the particular arrangement of the valves and passages described in the patent, the so-called process is merely the *function* of the apparatus. Hence, it would seem to follow conclusively that the claim, if it means to cover this function, is void, and if it means to cover the mechanism which performs the function, it must necessarily be construed to involve the *new valve* by which the train-pipe air is admitted on the final traverse of the piston. The claim specifies nothing which this Court has ever included in its definitions of a patentable process or method, but it specifies that which, in *Corning vs. Burden* and *Risdon Locomotive Works vs. Medart*, was expressly interdicted from the category of patentable inventions.

We respectfully submit that there are but two ways of looking at this claim—it is either a claim for *mechanism*, or a claim for the *function* of a mechanism. It says, in terms, that it is for a mechanism; and, in the specification, Mr. Westinghouse tells us, as plainly as language can express the idea, that it is *not* for the function but for the *structural features by which it performs* the further *function* of effecting the direct admission of air from the main air-pipe to the brake-cylinder." (See page 2, lines 41-44.) Will the Court hold that it is for a certain thing when Mr. Westinghouse says it is *not* for that thing?

IV.

An Estoppel.

The Court should hold that the learned counsel and experts for Westinghouse have *admitted* the claim to be, not for a process or method, but for a mechanism which includes the new auxiliary valve 41 and its by-passage ; and that this admission is conclusive upon the Court in this cause.

Those gentlemen and their experts have always taken that position. Their contention has invariably been that we infringe, not because we use the same process or method, but because, they say, we use their auxiliary valve 41 in another, but equivalent form. Thus, their expert, Mr. Newbury, says (Transcript, top of page 62) : "My understanding is that Mr. Westinghouse is only entitled to claim the 'mechanical devices' combined together by means of which he is enabled to accomplish the quick-action effect or result ; or, in other words, that he is entitled to claim mechanisms or instrumentalities combined together in substantially the manner set forth. Again, (near middle of page 28) he says : "This claim 2, when read in the light of the specification, as, I understand the matter, is for a combination of four essential elements or devices combined together to form a brake-mechanism." And (near bottom of page 46) he says that in his opinion the Boyden structure infringes the Westinghouse patent in suit, because "*In each there is an auxiliary valve or auxiliary valve device adapted to open direct communication between the main air or train-pipe and the brake-cylinder,*" etc. This is the theory upon which the complainants brought the suit, made up their evidence, and have always argued the case ; and to which the defendants were obliged to direct their defense. *We have never been called upon to meet the charge that we are infringing a process or method, and*

have directed no evidence to that question. We respectfully submit that the complainants, having elected to take the position which they have taken, are bound by that election, even though it should lose them the case; and that the Court, at this late stage of the proceedings, has no right to change the issue. In *Burt vs. Every*, 133 U. S., 349, this Court laid special stress upon the fact that the patentee's counsel, in his brief, had admitted that the claim was to be construed as for a device, and not for a process or method.

Respectfully submitted,

LYSANDER HILL,

Of Counsel for Boyden Brake Co., et. als.

No. 400 and 406.
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October Term, 1896. Nos. 403 and 426.

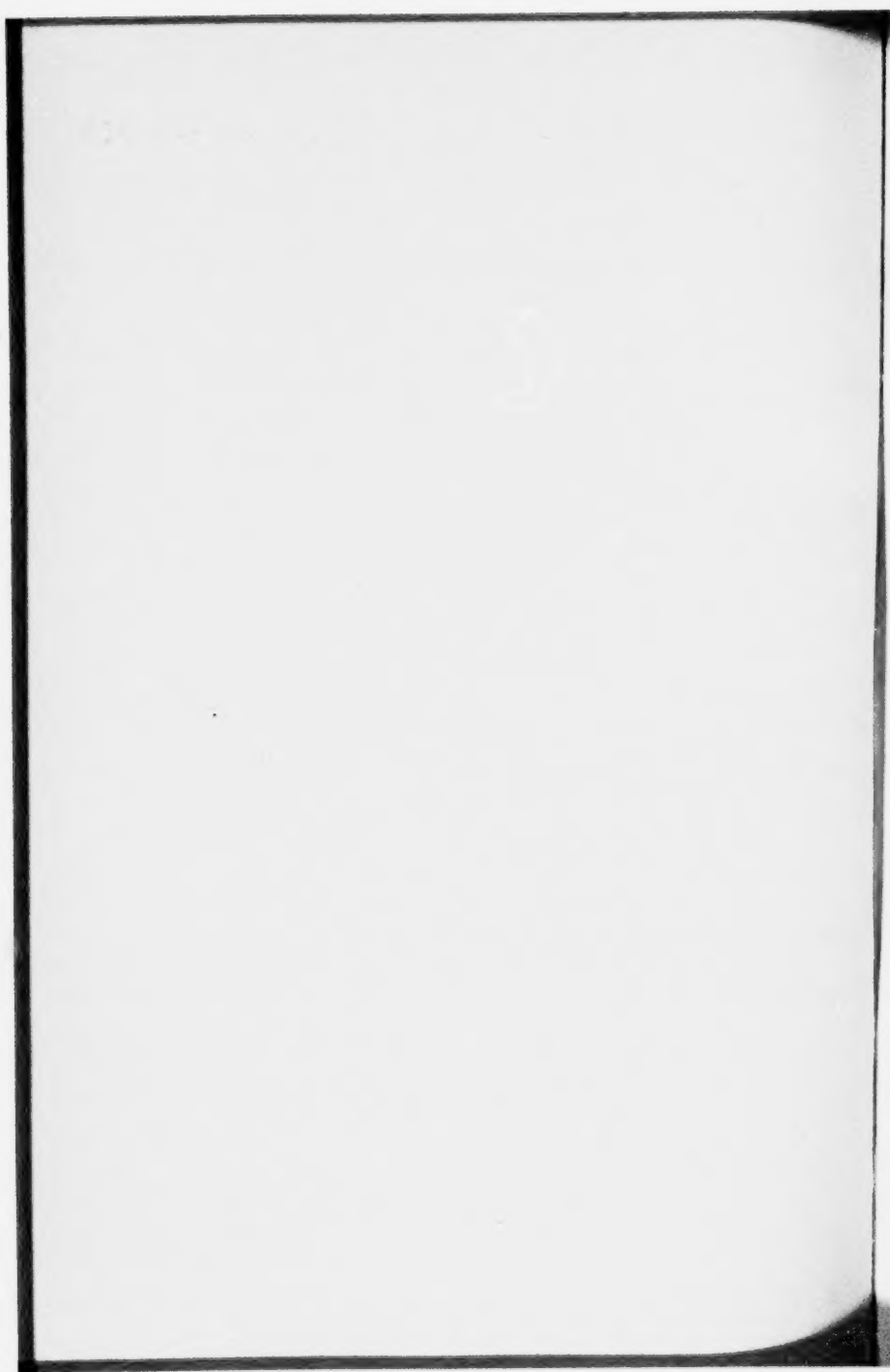
BOYDEN POWER BRAKE COMPANY.
GEORGE A. BOYDEN, President.
CHARLES B. MANN, Secretary.
WILLIAM WHITRIDGE, Treasurer.
AND
BOYDEN BRAKE COMPANY,
Appellants.
vs.
GEORGE WESTINGHOUSE, JR.,
AND
THE WESTINGHOUSE AIR-BRAKE CO.,
Appellees.

} APPEAL.

GEORGE WESTINGHOUSE, JR.
AND
THE WESTINGHOUSE AIR-BRAKE CO.
Appellants.
vs.
BOYDEN POWER BRAKE COMPANY.
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BOYDEN BRAKE COMPANY,
Appellees.

} CROSS-APPEAL.

EXTRACTS FROM THE
**Oral Arguments of Counsel
for Boyden Brake Co.**



Supreme Court of the United States.

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BOYDEN POWER BRAKE COMPANY *et alia*,
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APPEAL.

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Appellees.

CROSS-APPEAL.

WASHINGTON, D. C., March 1, 1897.

3.45 o'clock P. M.

EXTRACTS FROM THE ORAL ARGUMENT OF HECTOR T. FENTON, IN BEHALF OF THE BOYDEN BRAKE COMPANY.

May it please the Court, the questions which are presented in this record are, apparently, complex; but in point of fact they are exceedingly simple. If your Honors will kindly open the defendants' brief at page 68, you will observe two illustrations, the first of which is patent No. 220,556, the old triple valve, and the second of which is the patent in suit, No. 360,070. The upper picture represents the old automatic triple-valve, and

below it is the same valve exactly, plus the "additional members," consisting of an auxiliary-valve and by-passages, which your Honors will observe colored in red.

The defendants' machine, as plaintiffs will admit, and as the drawings show (opposite p. 69, defendants' reargument brief), has no by-passage other than what it had before in the old art. It has no valve other than what it had before in the old art. But it produces exactly the same result as the complainants' machine does. Why? Because Mr. Boyden discovered, as I shall show to your Honors later on by a parallel case, that the principle of a segregated machine, to wit, these "additional members," was wholly unnecessary to produce this quick-action result. He discovered that he did not need any segregated passage-way leading from train-pipe to brake-cylinder, nor did he need any auxiliary-valve to control that passage-way. How does he get the result? He discovered, may it please the Court, that he could go back to the old art which showed a triple-valve having a check-valve in its piston, and by producing differential pressures in the valve-chamber of the old triple-valve he could make it operate to obtain both the old automatic result and the quick-action result, thereby developing the latent powers of the triple-valve, and wholly dispenses with the "additional members" of the patent in suit or their mechanical equivalent in any form. When you understand that principle of the defendants' machine and when you look at the complainants' patent, you may see for yourselves whether you can reason out from the complainant's patent, or anything shown in his drawings or described in his specifications, the principle involved in the defendant's machine; and if you cannot, that is the end of this case. There is but one single issue involved here, and that is the issue of infringement.

MR. JUSTICE WHITE: Take it for granted that your premise is correct, would not a different rule apply to the patent of Mr. Westinghouse in determining whether these were equivalent to

his patent, and whether he was entitled to a very broad construction of his patent?

MR. FENTON: No, sir; I have in the brief four of the leading cases about pioneer patents—*O'Reilly vs. Morse* and *Morley vs. Lancaster*, and two others—which I will refer to in the course of the argument, when I reach that part of the case, and I shall show your Honors that there never has been a decision in this Court, even in the case of a pioneer patent, which will hold one machine to infringe another, if you reach the conclusion that the second machine does not involve the principle of construction of the mechanism used in the first machine, no matter if it produces the identical results, and no matter if the result was absolutely new with the complainant. That is exactly what this Court said in the case of *O'Reilly vs. Morse*, and it is exactly what you said in *Morley vs. Lancaster*, and what you said in two or three other cases.

MR. JUSTICE BROWN: Is not the decision in *O'Reilly vs. Morse* to a certain extent in conflict with the telephone case?

MR. FENTON: I think not.

My learned colleague asks me to suggest to your Honors, which is true, that the claim in controversy in the Bell telephone case was a method claim, and he will fully discuss that point in his argument.

File Wrapper of Patent in Suit.

I shall not take up the time to discuss the first and the fourth claims. In my humble judgment the first and the fourth claims are too plain to need any discussion; but I will take up the second claim and see what it is. It is the second claim that opens the door to an argument. The second claim reads in this way:

"2. In a brake mechanism, the combination of a main air-pipe, an auxiliary-reservoir, a brake-cylinder and a triple-valve having a piston whose preliminary traverse admits air from the auxiliary-reservoir to the brake-cylinder"

So far as I have read to you I have read only the combination of elements entering into the old automatic brake of 220,556. But the claim goes on to say :

“and which, by a further traverse, admits air directly from the main air-pipe to the brake-cylinder, substantially as set forth.”

That description of the function of the new machine is the only *new thing* in the claim, that is “and which, by a further traverse, admits air directly from the main air-pipe to the brake-cylinder, substantially as set forth.”

What means are to be imported into this claim to carry out this function of admitting train-pipe air to the brake-cylinder, because the elements referred to in the claim, will not perform the function without some means are applied in the claim. That is admitted on both sides.

What are those means? The means is undoubtedly a new “auxiliary-valve,” actuated on the further traverse of the piston, which valve controls a direct passage-way leading to the brake-cylinder.

When Mr. Westinghouse went to the Patent Office with this application, he was met with a rejection of this identical claim 2 in controversy, as well as a rejection of claim 1, which does not appear in this patent and which he erased and substituted a new claim for it. He was met with a rejection of these claims on a reference to Boyden's patent of 1883. He said this in regard to claim 2, and these are strong words :

“It is to be understood that applicant does not seek to broadly claim a device for admitting air directly from main air-pipe to the brake-cylinder.”

Then he goes on to describe several devices which do that.

“When, however, the triple-valve is provided with an auxiliary-valve, operated by its piston, which performs a new function additional to that of the triple-valve as previously employed, it is believed that such combination is wholly novel.”

Now what was his first claim which was *rejected*? His first claim was this:

"1. In a brake mechanism the combination of a main air pipe, an auxiliary-reservoir, a brake-cylinder, and a triple-valve, provided with a device for admitting air directly from the main air pipe to the brake-cylinder, substantially as set forth."

Then what did Mr. Wettinghouse do with this first claim? He substituted a new claim in which he changed the word "device" to "auxiliary-valve, independent of the main-valve." The Patent Office, the Circuit Court, and the Circuit Court of Appeals have all said that when Mr. Westinghouse spoke of the "auxiliary-valve" he spoke of a valve which was "independent of the main-valve" and not one with it, and part and parcel of it—not one valve performing two functions, but a valve independent of the main-valve, not only functionally independent of it, but physically independent of it.

But bear in mind this: that when the Patent Office rejected that original first claim, they also rejected this allowed second claim on the same reference. The two claims were rejected together. It was in order to get that second claim, the one now in controversy, passed by the Patent Office, that Mr. Westinghouse wrote the letter which I read to your Honors a moment ago, and which I will read again:

"When, however, the triple-valve is provided with an auxiliary-valve operated by its piston, which performs a new function additional to that of the triple-valve as previously employed, it is believed that *such combination is wholly novel*." R., p. 718, l. 41.

This letter clearly defines the meaning of claim 2.

This statement conclusively implies an *auxiliary-valve* in claim 2. The contents of this file containing this letter absolutely preclude the possibility of construing the allowed

claim 2 (allowed *after rejection*, allowed *after erasure* of the broad statement, allowed after erasure of this original first claim, and allowed *after receipt of this letter* defining the invention of *this claim 2* as a "combination" of an "auxiliary" valve with the old triple-valve, the piston or its "further" traverse being the actuating means), as being for the triple-valve *per se* admitting the train-pipe air to the brake-cylinder without any "auxiliary-valve" or any mechanical equivalent therefor in any imaginable form.

The Finding of Fact as to Non-identity by Three Tribunals.

We have taken the old triple-valve device which your Honors see, having a graduating valve and a main valve, and we have turned that into a machine which will accomplish the result, by doing what? Have we put in an additional passage-way which we did not have before? No. Have we added another valve that it had not before? No. Have we caused the piston to do anything more or less than it always did? No. We have taken the old triple-valve element, and have partitioned the valve-chambers to create differential pressures therein.

Your Honors will have to hold, in order to find identity, that the partitioning of the valve-chamber of the old triple-valve is the equivalent of adding a separate passageway and an additional auxiliary-valve to control it. *You cannot reason that out from the patent.*

In order to find identity, may it please the Court, the plaintiff will have to satisfy your Honors that, on the record in this case, three different tribunals, one after the other, made a mistake. In order to sustain their proposition that our main valve is the equivalent of their auxiliary and main valves combined; they will have to show your Honors that the Patent Office, when they considered our application for a patent, made a mistake.

Then they will have to take up the record and show to your Honors that Judge Morris, in the Circuit Court, was mistaken. Judge Morris stated that our black valve was a main-valve and not an auxiliary-valve, and that our yellow valve was the graduating-valve. He held that distinctly. They will have to reverse that on this record.

Then they will have to take up the opinion of the Court of Appeals and show to your Honors that the Court of Appeals made a mistake about the same thing, because all three of these tribunals, one after the other, said that our main valve was not the auxiliary-valve of Westinghouse, but was the old and original main-valve of the triple, and that it was none the less a main-valve of the triple, because by partitioning the valve-chamber it performed the additional function of admitting train-pipe air to the brake-cylinder.

On the Question of Non-Identity.

I ask your Honors, in considering the re-argument brief, pp. 43 to 54, to look at the somewhat famous case of *Burr vs. Duryee*, which I have taken the trouble to elaborate in the brief, because, in my humble judgment, that case is exactly on all fours with this.

In *Burr vs. Duryee*, counsel said this:

"Wells was the first who introduced any guiding and directing mechanism, and his introduction of that between the rotating picker and former produced a new machine, viz., the first machine which could successfully make hat bodies from the flying fur by guiding and directing the fur from the picker to the former. He may, therefore, treat as infringers all who used the machine with only a substitute for one of the parts of the combination, performing the office of the part for which it was substituted."

That is precisely the claim that is made here to-day by the learned counsel on the other side. What did Judge Clifford say

in answer to that proposition? He discusses the peculiar characteristics of the Wells invention, and says that it has a tunnel or guide between the picker and the rotating cone. Then he says that in the defendant's machine there is no tunnel or directing mechanism; just as in ours, we have no auxiliary-valve or separate and distinct segregated passage-way. We use the old main-valve and the old passage-way for reservoir-air to transmit train-pipe air to the brake-cylinder. Then he goes on to say:

"Now, an infringement involves substantial identity
 "whether that identity be described by the terms, same
 "principle, same *modus operandi* or any other. It is a
 "copy of the thing described in the specifications of the
 "patentee, either without variation, or with such varia-
 "tions as are consistent with its being in substance the
 "same thing. If the invention of the patentee be a
 "machine, it will be infringed by a machine which
 "incorporates in its structure and operation the sub-
 "stance of the invention; that is, by an arrangement of
 "mechanism which performs the same services or pro-
 "duces the same effect in the same way, or substantially
 "the same way." (1st Wallace.)

He says here, that the argument in that case, which is substantially similar to the argument in this case, is an argument not that the two machines are alike in principle of construction, but is an *argument that they produce the same result*, and he says that when you argue that because two machines produce the same result they are equivalent, it is an abuse of the term "equivalent."

If we apply the test which was applied in *Burr vs. Duryee* to this case, your Honors will see how forcible the argument is here. Suppose that Mr. Westinghouse's patent to-day was a reissued patent? I have shown you from the original patent that the machine which he describes is a combination of these old elements, plus these additional members. Suppose he had reissued that patent and described this thing? Would your

Honors hesitate for an instant to say, upon a comparison of the two things, that he was taking a reissue for a *different* invention? Is it any the less a different invention because it is made the subject-matter of a subsequent patent to an independent inventor? Certainly not.

The Burden of Proof on Plaintiff.

I now desire to call your Honors' attention to one other matter which seems to me to be of controlling importance. You have here a single issue in this case, an issue of fact: Are these machines identical or are they different? The patent is not attacked for want of novelty. It is not attacked for invalidity in any respect upon any proper construction of its claims; but it is a pure, bald issue of fact, infringement or non-infringement.

Now the burden of proving that, as we all know, is on the plaintiff, who seeks to discharge that burden by his testimony in chief. And when the defendant comes into court and lays down their patent with broad claims in it, differentiating this device from that device; when, upon the face of the defendant's patent you see that the patent itself is based upon this question of identity, then, I say, that under the decisions of this court which are cited in full in the brief, the latest of which is the *Miller vs. Eagle Company*, 151 United States, the burden of proof is shifted back on the plaintiff.

Have they answered it? In this case you have heard remarks made by learned counsel who opened the case for the Westinghouse Company, that Mr. Westinghouse said this and Mr. Westinghouse said that. The Mr. Westinghouse who said these various things was not Mr. Westinghouse the patentee, but his brother. Mr. George Westinghouse, the inventor, is one of the plaintiffs in this case. The plaintiffs are the Westinghouse Air Brake Company and George Westinghouse, Jr. Has Mr. George Westinghouse dared to come upon the stand and say that his

invention included the invention described and claimed in the Boyden patents? No, sir; he is silent.

Has Mr. Boyden come upon the stand and told you the evolution of his device in controversy. Yes, sir, frankly, and he has been cross-examined at length.

When you consider upon whom is the burden of proof; when you consider the file and contents of the application for the patent in suit; when you consider the granting of the patent to us raising a *prima facie* conclusion of radical differences; when you consider the broad claims in our patent, which the patent office must have passed upon and did pass upon; when you find that even under their own theory the Circuit Court has said that our main pop-pet-valve 22 is not the auxiliary valve 41 of the patent in suit; when you find that the Court of Appeals has said the same thing upon this issue of fact, upon that vital question in the case, you must also consider that you have no answer from Mr. George Westinghouse denying our proposition. You have Mr. George Westinghouse absolutely silent upon that question. I say, may it please the Court, that he has not discharged the burden of proof, and that the case ought to be with us.

EXTRACTS FROM THE
ORAL ARGUMENT OF LYSANDER HILL
 ON BEHALF OF THE BOYDEN BRAKE CO.

May it please the Court, I shall commence my remarks by referring to a point which was suggested by one of your Honors yesterday; to wit, the condition of the law as to what are and what are not pioneer inventions.

As I understand the law, there are four great decisions of this Court which have substantially laid down all the law that is involved in this case. Those four cases are: *O'Reilly vs. Morse*, 15 Howard; *Burr vs. Dwyer*, 1 Wallace, and *Morley vs. Lancaster*, 129 United States, which were cited by my friend, Mr. Fenton, and the more recent case of the *Incandescent Lamp Patent*, 161 U. S.

In *O'Reilly vs. Morse*, the great Morse telegraph was involved. In the patent for which Mr. Morse had made a claim for the transmission of intelligence to a distance by means of a current of electricity, irrespective of the means employed. This Court, as your Honors are perfectly well aware, held that claim (the 8th) to be invalid, as being a claim for an effect or result, and such has been the law, not only in this court, but following it in all other courts of this country, and in England too, from that day to this.

In the English courts, prior to the case of *O'Reilly vs. Morse*, the question had arisen in the great case of *Neilson vs. Harford*, on the hot-air process of smelting iron. Neilson made a very broad claim, in that case, as your Honors will remember, and the English courts, after great litigation and after argument by the most eminent counsel in the realm, came finally to the conclusion that the patent could not be sustained as for the

result of manufacturing iron by the use of the hot-air process; but that the patent was to be treated as a patent, practically, for a combination of mechanical elements which were used by Neilson in producing this result. Upon looking at his patent and the description given therein, they found that the combination of elements which he used consisted of three in number, to wit, the smelting furnace in which the iron was to be treated; a fan blower or equivalent air-pump for creating a blast of air, with a pipe leading from the blower to the smelting furnace; and, interposed between the fan blower and the smelting furnace, a heating device to heat the pipes through which the air passed to the furnace, so that the air started in its movement by the fan blower and heated in its course by the heating device, would enter the smelting furnace hot and produce the result.

The English Court held that if the Neilson's patent was to be considered broadly for the means of applying hot air in a blast furnace, it would be invalid as for a principle, or a result or an effect; and in order to validate the patent it was necessary to confine it to the means which were employed by Neilson for effecting the result. Those means were the combination of three elements, the fan-blower, the smelting furnace and the heater arranged between the blower and the furnace.

That case practically notified the world that if anybody else found any other way of applying hot-air to a blast furnace, any different way of using even these elements it would avoid the patent. For example, if it had been found practical to put the fan-blower between the heater and the furnace, that would, under their construction, have avoided the claims of the patent. The combination must be a combination of those three elements arranged in that way.

That has been the law of England from that day to this. They do not allow, any more than this Court allows, a claim for a result or effect, but they limit the inventor *to the means* by which he produces that result or effect and to the means

or their mechanical equivalents which he describes in his patent for producing it. Such was the doctrine of the case of *O'Reilly vs. Morse*, in this court.

The question was asked yesterday by Mr. Justice Brown, whether there was not something in the Bell telephone decision which had modified that theory of the law, to which question I now desire to answer most emphatically, No. There is nothing in the Bell telephone decision that modifies *O'Reilly vs. Morse*, in any respect whatever, as I understand the decision, and I think I understand the facts upon which the decision was based. The Bell telephone patent raised a different question altogether. The broad claim in that patent was *not* for an effect or result. It was for a method. Bell was not claiming the transmission of vocal sound to a distance by a current of electricity, as Morse was. If he had made *such* a claim this Court would have immediately pronounced the patent invalid, on the same ground that they held Morse's eighth claim invalid. Helmholtz, long before Bell's time, had discovered the fundamental laws of sound. He had discovered the form of sound waves and he had found the peculiar fact that sound waves in the air are not abrupt, but are undulatory; that each wave is in form a combination of what musicians call *crescendo* and *diminuendo*. It commences and rises like a wave of the sea, and then settles down again to a level, gradually and not abruptly. Sound waves are capable of being delineated graphically by serpentine lines, by sinuous waved lines, such as appear in a rope when one end is fastened to a post and you take the other end in your hand and wave it up and down. Helmholtz discovered that *that* was the peculiar form which sound waves take in the air. Before Bell's time, Philip Reis, in Germany, had attempted to invent a telephone. He was a philosopher, and was perfectly familiar with the Helmholtz theory of sound waves. He undertook to transmit sound, not by putting the current on the line in the form of an

undulatory current, but by a sharp make and break current, and to transfer that into undulations in the diaphragm. That was his attempted method of reaching the result. It failed because the receiver was incapable of transmitting the sharp, abrupt make and break current on the line into gradual undulations and sinuous movements.

Bell, as held by this Court, evolved another theory. He evolved the theory that if he could go back one step from Reis and take the current on the line wire and put that current into the form of undulations, he could then accomplish the result, because the receiving diaphragm would then take the same vibrations as the current on the line. Bell therefore provided *a method* or mode of transmitting speech, not as Reis had done, by a make-and-break current, and by seeking to transform that into undulations at the receiver, but by the other method of putting on to the telephone line itself a current in the form of an undulation. He skillfully drew his patent to cover that as his method—not to broadly cover a current of electricity—but to cover the method of transmitting speech by putting upon the line wire these current undulations which could be graphically described by sinuous or serpentine curves, and his claim was for that method.

I hold in my hand Volume 126 United States Reports, in which Bell's claim was discussed by the Court, and on pages 531, 532 and 533 your Honors will find the point at which the Court discussed that question.

The Court said :

“In this art—or, what is the same thing under the
“patent law—this process, this way of transmitting
“speech, electrically, one of the forces of nature, is
“employed: but electricity left to itself will not do
“what is wanted. The art consists in so controlling the
“force as to make it accomplish the purpose. It had
“long been believed that if the vibrations of air, caused
“by the voice in speaking, could be reproduced at a dis-

"tance by means of electricity, the speech itself would
 "be reproduced and understood. How to do it was the
 "question.

"Bell discovered that it could be done by gradually
 "changing the intensity of a continuous electric current,
 "so as to make it correspond exactly to the changes in
 "the density of the air caused by the sound of the voice.
 "This was his art. He then devised a way in which
 "these changes of intensity could be made and speech
 "actually transmitted. Thus his art was put in a condi-
 "tion for practical use.

"In doing this, both discovery and invention, in the
 "popular sense of those terms, were involved. Discovery
 "in finding the art, and invention in devising the means
 "of making it useful. For such discoveries and such
 "inventions the law has given the discoverer and
 "inventor the right to a patent—as discoverer for the
 "useful art, process method of doing a thing he has
 "found, and as inventor for the means he has devised to
 "make his discovery one of actual value. Other inventors
 "may compete with him for the ways of giving effect to
 "the discovery, but the new art he has found will belong
 "to him and those claiming under him during the life of
 "his patent. If another discovers a different art or
 "method of doing the same thing, reduces it to practical
 "use, and gets a patent for his discovery, the new dis-
 "covery will be the property of the new discoverer, and
 "thereafter the two will be permitted to operate each in
 "his own way without interference by the other. The
 "only question between them will be whether the second
 "discovery is, in fact, different from the first.

"The patent for the art does not necessarily involve a
 "patent for the particular means employed for using it.
 "Indeed, the mention of any means, in the specification
 "or descriptive portion of the patent, is only necessary to
 "show that the art can be used: for it is only useful
 "arts—arts which may be used to advantage—that can be
 "made the subject of a patent."

The Court is now speaking of claims for a method. Passing to the next page, the Court refers to this very case of *O'Reilly vs. Morse*, and says:

"In *O'Reilly vs. Morse*, 15 Howard, 62, it was decided
 "that a claim in broad terms for the use of the motive
 "power of the electric or galvanic current called electro-
 "magnetism, however developed, for making or printing
 "intelligible characters, letters or signs at any distances,
 "although a new application of that power first made by
 "Morse, was void because it was a claim 'for a patent for
 "an effect produced by the use of electro-magnetism,
 "distinct from the process or machinery necessary to
 "produce it'; but a claim for 'making use of the motive
 "power of magnetism when developed by the action of
 "such current or currents as set forth in the foregoing
 "description, as a means of operating or giving motion
 "to machinery, which may be used to imprint signals
 "upon paper or other suitable material, or to produce
 "sound in any desired manner for the purpose of tele-
 "graphic communication at any distances,' was sustained.
 "The effect of that decision was, therefore, that the use
 "of magnetism as a motive power, without regard to the
 "particular process with which it was connected in the
 "patent, could not be claimed, but that its use in that
 "connection could."

The Court further says, at the top of page 535:

"We see nothing in *Morse's* case to defeat *Bell's* claim.
 "On the contrary, it is in all respect sustained by that
 "authority."

There is nothing in the case of *O'Reilly vs. Morse* that conflicts or interferes with the view of the law which this Court expressed in the Bell telephone patent. There is no conflict between the two decisions. In the Morse case he simply sought to claim the use of the electric current, generally, without any reference to a method, the machinery or means for marking signs at a distance. In Bell's case, if the Court is correct

in its conclusions, there was the discovery of a certain method by which an undulating current of electricity which when transmitted under a condition which he describes and which was the subject of his invention, would accomplish that result, and his claim was made for that method, and was sustained as being for that method.

The case of *O'Reilly vs. Morse*, as I understand it, has never been doubted or modified in any respect whatever, either in this country or in England since the decision was made in 1853. On the contrary, it has been repeatedly affirmed, both here and there.

I would like to read to your Honors the language of the Court in the case of *O'Reilly* against *Morse* and embody it in my argument, because I am satisfied that no lawyer at the bar can state the principle of the law more clearly and more logically than it is stated in this opinion :

“Whoever discovers that a certain useful result will be produced, in any art, machine, manufacture or composition of matter, by the use of certain means, is entitled to a patent for it; provided he *specifies the means* he uses in a manner so full and exact, that any one skilled in the science to which it pertains can, by using the means he specifies, without any addition to or subtraction from them, produce precisely the result he describes. And if this cannot be done by the means he describes, the patent is void; and, if it can be done, then the patent confers upon him the exclusive right to use the means he specifies to produce the result or effect he describes, and nothing more. And it makes no difference, in this respect, whether the effect is produced by chemical agency or combination; or by the application of discoveries or principles in natural philosophy, known or unknown before his invention; or by machinery acting altogether upon mechanical principles. In either case

“he must describe the manner and process as above mentioned and the end it accomplishes, and *any one may lawfully accomplish the same end without infringing the patent, if he uses means substantially different from those described.*”

No principle of law was ever stated more clearly by any court than this principle is stated by this Court.

Burr vs. Duryee Case.

The case of *Burr vs. Duryee* has been referred to by my learned friend, Mr. Fenton. That case was also a case of a pioneer invention or discovery—a pioneer patent.

Your Honors will find, if you choose to refer to it, in Mr. Fenton's re-argument brief, p. 52, a full illustration of the machines in that case, pointing out the difference caused by defendant omitting the interposed guiding tunnel. The defendant made a different combination and avoided the combination of the patent, and this court held that the patent, although a *pioneer* patent, did not cover the machine *when that element was omitted*. It was an essential element of the combination described in the patent, and this court was obliged to hold that its use was essential to the patent, and that he who discovered how to omit it avoided the patent. This court was obliged to so hold in order to be consistent with its own repeated decisions.

Incandescent Lamp Case.

The incandescent lamp case was a recent case decided by the judges who are now on the bench, or nearly all of them, about two years ago. That is a case which, in my judgment, is “on all fours” with the case which is before you today. Your Honors will remember it, for you heard and decided it. Sawyer and Man had discovered that carbonized paper fibre was a useful element out of which to construct the filaments of incandescent electric lamps. They took out a patent upon it,

and as paper fibre is a vegetable substance, the attorney who drew their patent thought that he could broaden their patent for them and make it squarely cover all possible infringements by taking it in its character as a "*vegetable fibre*" and describing the discovery or invention as a discovery of a *vegetable fibre*. The claim, therefore, was drawn for the use of "carbonized vegetable fibres" or textile material in constructing the filaments of incandescent lamps. When that case came before this Court, your Honors held that Sawyer & Man had not discovered all vegetable fibres or the utility of all vegetable fibres for that purpose. They had discovered the utility of *paper* fibre for constructing the filaments of incandescent lamps, but yet that fact did not entitle them to go beyond their discovery of paper fibre and include all kinds of vegetable fibres within the range of their discovery. They had *not* discovered that all kinds of vegetable fibres would produce the result.

It turned out upon investigation that a good many vegetable fibres were not suitable for making filaments for incandescent lamps, but only some of them were. Among those which were of a proper character for that purpose Edison afterwards discovered that the fibre of a certain bamboo which grows in Japan and the Eastern islands was peculiarly fitted for that purpose, and was better, even, than the paper fibre. After investigating all the vegetable fibres that he could learn of or bring under his processes of investigation in his laboratory, he settled down upon *that bamboo fibre* as the best fibre known or attainable for the purpose, and he patented it and used it. Of course Sawyer & Man, the owners of the patent, brought suit against the Edison Company for an infringement of their patents. Edison was using "carbonized vegetable fibre" material, and their patent broadly covered carbonized vegetable fibre material.

Why was it not an infringement? Sawyer & Man were the first to use carbonized vegetable fibre in the form of this

paper fibre. But your Honors told the complainants there, Sawyer & Man, or their representatives, that the discovery that paper fibre was suitable for that purpose was not a discovery that *all vegetable* fibres were suitable for the purpose, and that their discovery was limited to paper fibre. They had discovered *that*, and they had not discovered anything else; and although the terms of their patent were broad, covering the whole vegetable world, you limited them right down to carbonized paper fibre, upon the ground that *that* exhausted their discovery. The defendant, in that case, was held not to infringe.

I say that the principle of that case is "on all fours" with the case here, and that is the general principle which runs through all these pioneer cases, or cases of so-called pioneer patents.

A man who has made a discovery is entitled to a patent commensurate with that discovery. If the terms of his patent or the claims go beyond the actual invention which he has made, they must be restricted, by construction, and confined to the invention which he has made. Bell's claim was for the method of putting the undulatory current on the line wire. It was not necessary to restrict that, because *that* was the invention which was made. In the case of the hat-body machine, the claim was for a combination of three elements, the picker, the guiding tunnel, and the receiving cone. That was the combination described. But your honors held, in that case, that if anybody left out one element of *that combination* they avoided an infringement.

In the Neilson case, in England, the Court construed the invention as including three elements, the fan-blower, the heater and the furnace, arranged in that relation, and they held that if anybody omitted any one of those elements, such omission avoided the combination.

These were all "pioneer" patents; but a pioneer patent is limited to the invention which it describes. Because it is a

pioneer patent it is not to be taken as broadly covering, not only what the man invented, but everything also that others could invent to accomplish the same result. If anybody could discover to-day, or hereafter, that speech could be transmitted telephonically by the use of some other current than the undulatory current on the line, the inventor would be entitled to a patent free of the Bell patent. The Court so held and so stated, in terms, in their decision. Bell's monopoly was based upon the fact that during the seventeen years of the existence of the patent nobody did discover any other way of getting electric transmission of speech except by the use of this undulatory current on the wire; but, *non constat*, that might be discovered at some future time. But it has not yet been done, and Bell's patent, while it stood, covered all the ways known to us for the transmission of electric speech; but the Court left it free, and his claim left it free, for anybody to discover some other way of producing that result, and to patent it and maintain the patent.

Let us apply that principle to the patent here. Mr. Westinghouse made a certain invention in 1886. He discovered that if he would take the old triple-valve, without changing it, which did not produce that rapid serial effect, and would make another passage-way from the train-pipe to the open atmosphere or to the brake-cylinder—for he first put it in the form of a passage-way to the atmosphere, and next in the form of a passage-way to the brake-cylinder—and control that new passage-way by a *new valve* which had not been on the apparatus before, and operate that new valve with the triple-valve piston, so that in making the emergency stop the triple-valve piston would move out and strike and unseat that new valve, compressed air could be admitted into the brake-cylinder from the train-pipe. *That* was his (Westinghouse) invention. There is no other to be found in his patent. His invention consisted in that new combination.

He patented that combination. The patent cannot go beyond it, because there was nothing beyond it described. If his

patent in terms goes beyond that combination, your Honors should say to him just as you said in effect in the case of *Sawyer and Man*: "You have drawn a patent which goes beyond your invention, and includes what you did not discover or invent; and your patent, therefore, must be limited back to your invention by construction."

Mr. Boyden discovered that the old triple-valve *per se* possessed latent powers unknown and undeveloped, and he invented means, partitioning the valve-chamber, by which those latent powers were brought into active service to vent the train-pipe air simultaneously with the admission of auxiliary-reservoir air to the brake-cylinder. By Boyden's invention the old main-valve of the triple-valve was made to vent both the airs. Therefore it is obvious that Boyden uses the old triple-valve to vent the train-pipe air, whereas Westinghouse invented "additional member" to the triple-valve, which forms no part thereof. Plainly the case at bar is on all fours with the Incandescent Lamp case.

**The Patent in Suit not a Pioneer, not a Success,
nor is it Used.**

But when Mr. Westinghouse made that combination of this patent 360,070, here in suit, he did not accomplish what my learned friend, Mr. Christy, told you yesterday by means of that patent. Mr. Christy said that the invention consisted in reducing the time of the application of the brakes throughout the length of the train from twelve seconds to two seconds. It is true that was done, but it is *not* true that it was done with this patent. This patent did not by any means reduce the time of application from twelve seconds to two seconds. The reduction of time from 12 seconds to 2 seconds was accomplished by a patent taken out by Mr. Westinghouse a year later, patent No. 376,837, dated in January, 1888. Under the patent in controversy Mr. Westinghouse undertook to accomplish the result of *preventing*

shocks on long trains. Did he do it with this invention? No. The result shown by the tests at Burlington, Iowa, was to more than double the amount of the shock to the train. Instead of the device of this patent tending to prevent and reduce the shock, it *increased* it to such a ratio that while in the first test made in 1886 with the old triple-valve the shock was in the proportion of 49—the slidometer moved 49 inches in response to that shock—the second test, in May, 1887, when Westinghouse came to try the Device of the patent here in suit, the shock was 103 inches, or more than double that under the old triple-valve. The device was then and there withdrawn as unfit and unsafe for use, and it never was used afterwards. He then and there abandoned the use of the structure and never resumed it. The device of this patent in suit has never been advertised by him to the world. You cannot find it in any catalogue issued by the Westinghouse Company from that day to this. It never has been manufactured from that day to this, and it never has been sold by that company from that day to this. The reason for that is it was deemed too dangerous to sell.

On that point, I wish to read the testimony of Mr. Herman Westinghouse, the brother of Mr. George Westinghouse, who did not testify in his own behalf. Commencing on page 117 of the transcript:

“The result of these tests were disappointing. None
 “of the competitors, in the estimation of your committee,
 “did satisfactory work, owing to the *violent shock pro-*
 “*duced in stopping.*”

After the experiments made at that test, the Master Car Builders' Committee in charge of the tests reported in these words:

“At the conclusion of the 1886 trials, the committee
 “felt that to sum up any results in the face of so large a
 “field for improvement, could not but be unsatisfactory,
 “and while a wonderful advance has been made in the

"brake problem, as will be seen by a comparison of the stops of each year, *the 1887 tests* (with the device of patent in suit) *apparently leave the field for improvement open as wide as in 1886.*"

Then they go on to recommend, *not* this brake, but an electric brake, and they say :

"While we are not prepared to make any definite recommendation at this writing as to what freight train brake should be generally adopted, our present information, derived from the recent tests, points to two conclusions:

"1st. That the best type of brake for long freight trains is one operated by air, and *in which the valves are actuated by electricity.*"

That type of brake was shown, and it was found to answer the purpose perfectly. There was absolutely no shock when the air was admitted to the brake-cylinder by the action of valves actuated by electricity. Then follows on pages 127 and 128 a tabulated statement of the *slide* of the shock-measuring instrument, and the degree of the shock in the 1887 test. With the Westinghouse fifty-car train the shock in inches is shown to be 103, afterwards 70 $\frac{3}{8}$, and afterwards 70 $\frac{1}{2}$, and then this device of patent in suit was dropped.

The committee then says that the brilliancy of the Westinghouse record—that is, of the air-brake test—"was completely spoiled by the fearful shock given at the rear end of the train."

The same train was then tested electrically, with the following results :

Shock denoted by the instrument in inches, *none*. There were four tests and no shock whatever, not even an inch, while that of the Westinghouse device, under the patent in controversy, was 103 inches.

Mr. Herman Westinghouse, in his testimony, says :

"The conclusion of the 1887 trials, instead of furnishing to the railroad the desired information upon which

"to take prompt and reasonable action, seemed to show
 "that *much yet remained to be done* before it could be
 "safe to make a practical move in a matter of so great
 "importance. These sentiments are clearly expressed in
 "the committee's conclusion of the 1887 trials."

Somewhere in the record, although my eye does not light upon it now, he states that the train with the device in suit was withdrawn from further test on the ground that it *was not deemed prudent to use it*, and it was not tested again. In the course of his testimony he says that they have never made these brakes from that time to this, nor sold them since, nor advertised them in their catalogue.

This, then, is their so-called "pioneer" patent, a patent which did not accomplish the result and which doubles the injury. Moreover, it is not a pioneer patent in the sense of being the first to utilize or to state the principle of quick-action—the local venting of the train-pipe at each car. *That was* fully and completely stated in the prior patents of Mr. Westinghouse, in 1879, No. 217,838. In that patent a full description was made of the effect of venting the train-pipe at numerous points along the train, not remote from the auxiliary-reservoir of each car, and this patent says that the injuries resulting from the old system are avoided by the use of such expedients and a *nearly simultaneous* application of all the brakes is produced.

My friends on the other side say of this patent 217,838 that it was not practical. They say they did not make it and put it into use. We answer, they did not make this device of the patent here in suit and put it into use after its defects were shown at Burlington. *If the 1879 device is not practical for that reason, neither is this, for the same reason.*

But the defendants in this case made a complete set of 217,838 suited for fifty cars, and tested them at their works in the presence of complainants' counsel, and under all the conditions that could be demanded for their use. They were found to work just as well as this device in suit works. My brother

Christy said here yesterday that while the valve of that patent 217,838 could be opened, *it could not be closed*. Mr. Christy was not present when they were tested; he is mistaken. There is not the slightest trouble in closing that valve. In these experiments made in Baltimore with the fifty brakes of that patent, the valves were closed as easily as they were opened. That is a mere fiction of my brother Christy's imagination. That device will both open and close the valves, and it is a "quick-action" device.

Mr. Westinghouse, himself, was not even the first to discover the utility or principle of action of that relief-valve, which is the fundamental law of quick-action. The prior English patent to Sanders, in 1879, referred to by Mr. Newberry, the Westinghouse expert, in the course of his testimony, also exhibited that kind of a quick-action relief-valve. They are all quick-action valves, because their effect is to locally vent the train-pipe under the different cars and produce quicker action.

"Shock," in stopping a long train quickly, is caused from the fact that without those local vents the air has to travel the whole length of the train-pipe to get out at the front end; but if there can be numerous vents provided along the train-pipe, the air will escape much quicker and thereby cause the application of the brakes much more quickly. And wherever those local vents are provided in an air-brake which is capable of operation, the whole principle of quick-action devices is involved and made public, and it then becomes merely a question of the form of a device or the construction of a device. He who subsequently takes out patents on a quick-action device must limit his invention or claims to the construction of his device, or to his particular combination. I do not mean to say that he must limit it down to the structural form, in that one thing must be round and not square, or anything of that kind; but I mean that he must limit it to the combination of elements which he invents as a means for obtaining quick-action.

May it please the Court, increased power in the brake-cylinder was not the essential object of this invention. There was no trouble in getting all the power that was necessary under the old, plain triple-valve. You cannot, in these air-brakes, increase the power beyond a certain degree. If you apply the brakes with too great power you slide the wheels of the cars on the track rails, and if you slide the wheels of a car even once you are liable to ruin every wheel by wearing flat spots on the wheel rim. You have to carefully guard against that, and you must apply the brake power to such an extent only as will check the wheels and not stop their rotation—not slide them. If you apply more than fifty or fifty-five pounds air-pressure in the brake-cylinders on these levers, as they are now constructed, you will be liable to slide the car wheels and thereby ruin them.

There was no trouble in getting fifty or fifty-five pounds of air-pressure with the old automatic brake; not the least. The old automatic brake gave a pressure in the brake-cylinders of forty or fifty pounds, and more if you wanted it. All you had to do to get greater pressure was simply to enlarge your auxiliary reservoirs. There was no trouble about that. Ordinarily the auxiliary reservoir is about double the capacity of the brake-cylinder. If it was only of the same capacity as the brake-cylinder, then when the air from the reservoir was admitted into the brake-cylinder, if there was seventy pounds of pressure in the reservoir, it will equalize in the brake-cylinder at thirty-five pounds, one half in each. Now, plainly, if the capacity of the reservoir is made twice as large as the brake-cylinder, and there was seventy pounds in the reservoir, the air will equalize in both at about forty-seven pounds of pressure. Make the auxiliary-reservoir a little larger, and on equalizing the air-pressure you would have fifty or fifty-five pounds in your brake-cylinder.

In the argument of the case in the Court of Appeals below, this fact was admitted by my learned friend, Mr. Betts, on the

other side. I hold in my hand a printed report of the arguments before the Circuit Court of Appeals at Richmond, where my brother Betts says:

"But here let me say that quick-action does not involve
 "greater power of the brake. It is not a question of
 "greater force of brakes as applied to the brake-shoes of
 "any individual car. The force with which the brake-
 "shoes are applied to any individual car is no greater
 "with the Westinghouse quick-action brake, which is in
 "controversy here, than it was with the old automatic
 "brake."

So increase of power was not the point. The point was to get
 "quick-action."

What Mr. Westinghouse was after was to *vent the train-pipe quick*, so as to produce rapid serial action in the brake, and *thereby prevent shock at the end of a long freight train*. He did not accomplish it with this patent. He accomplished it with a subsequent patent taken out in 1888—No. 376,837—a patent we are not sued on.

Why did they fail to accomplish it here? And why did they finally accomplish it there? Because the second patent, the patent of 1888, the successful one, went back, in plain terms, to the old relief valve of 1879 and adopted that form, which had a supplemental piston.

When Mr. Westinghouse put *that* old 1879 device into his triple-valve case he achieved success, and not till then. In the patent in suit he did not put in that device.

In the latter patent, after the device in suit had failed at Burlington, and had been discarded, Mr. Westinghouse, according to the record, spent about four months in trying to discover how he could make a valve that would operate. It was no easy matter. Mr. Herman Westinghouse testifies at considerable length as to the great difficulties involved in overcoming the troubles experienced in the Burlington tests, and in devising a

new brake which would relieve the shock; and it was only after car load after car load of materials had been sent from Pittsburgh to Burlington, and the whole summer of 1887 had been spent in working upon it, that it was discovered how to accomplish the result. Herman Westinghouse says when he did accomplish that result he produced a brake which has become the standard brake since that time. That is true. What did he produce by that four months of effort? What did become of the standard brake from that time on? We answer the device of patent 376,837, dated January, 1888. The Westinghouse brake of commerce to-day. You do not see any slide-valve in this latter device actuated by the further traverse of the piston, but you have here a reproduction of the old device of the 1879 patent, 217,838, the relief-valve patent. You have the supplemental piston and the valve taken bodily from the old device of 1879. (See illustrations p. 89, re-argument brief for Boyden.)

When he got that device, which consisted simply in transferring this old relief valve from the train-pipe, as he had it in 1879, to the triple-valve casing, and putting it in a separate chamber and operating that supplemental piston by air let in through the main-valve, he got a successful device. But so long as he relied on the auxiliary-valve, actuated by the further traverse of the piston, he was totally unable to accomplish the result. When he got the valve of patent 376,837 of 1888, and found that it accomplished the result in two seconds, that form of valve, 360,070, the patent in suit disappeared.

We are not sued on the patent of 1888. The suit against us is on the 1887 patent, which has been discarded by Westinghouse himself. He has not brought any suit against us on the successful patent.

Supreme Court of the United States

OCTOBER TERM, 1895.—Nos. 847 and 878.

BOYDEN POWER BRAKE COMPANY—

GEORGE A. BOYDEN, President ;
CHARLES B. MANN, Secretary ;
WILLIAM WHITRIDGE, Treasurer—

AND

BOYDEN BRAKE COMPANY,
Appellants,

vs.

GEORGE WESTINGHOUSE, JR.,

AND

THE WESTINGHOUSE AIR-BRAKE CO.,
Appellees.

Appeal.

GEORGE WESTINGHOUSE, JR.,

AND

THE WESTINGHOUSE AIR-BRAKE CO.,
Appellants,

vs.

BOYDEN POWER BRAKE COMPANY—

GEORGE A. BOYDEN, President ;
CHARLES B. MANN, Secretary ;
WILLIAM WHITRIDGE, Treasurer—

AND

BOYDEN BRAKE COMPANY,
Appellees.

Cross-Appeal.

PETITION.

THE PETITION OF BOYDEN POWER BRAKE COMPANY, GEORGE A. BOYDEN, PRESIDENT; CHARLES B. MANN, SECRETARY; WILLIAM WHITRIDGE, TREASURER; AND BOYDEN BRAKE COMPANY, PARTIES TO SAID APPEAL AND CROSS-APPEAL.

Your petitioners humbly pray that said cause, which was brought to this Court by a writ of *certiorari*, issued on the 27th day of January, 1896, to the Circuit Court of Appeals for the Fourth Circuit, may be advanced and set for hearing at an early date, to be fixed by this Honorable Court, the circumstances of this case being special and peculiar, within the meaning of Rule 26, and not liable to furnish a precedent for other cases.

The grounds upon which your petitioners pray this relief are given below, together with brief statements of facts necessary to the proper understanding of them. They are as follows, to wit:

1. The automatic air-brake for railroad cars was originally invented by George Westinghouse, Jr., about the year 1872, and his broad patent for it expired in 1889. It operated by means of what was called a "triple valve." It was well adapted for short trains, such as passenger trains; but when applied upon long freight trains it proved impracticable, because, in stopping the train suddenly with the full force of the brakes, in cases of emergency, the interval between the setting of the brakes on the extreme forward cars and the extreme rear cars was sufficient to produce great "shocks" upon the latter, or, in other words, sufficient to allow the rear cars, while yet free from brake pressure, to run forward at full speed and collide, with great violence

and often disastrous results, against the forward cars already checked in their movement by the speedier application of their brakes.

The application of electricity had made the fact known that, if all the brakes on a long train be set with full force at substantially the same moment, all the cars will "slow down" simultaneously, and there will be no "shock." The employment of electricity, however, to operate the valves of an air-brake apparatus was objectionable; and it became desirable therefore, that other means should be contrived whereby the interval between the application of the brakes upon successive cars should be reduced sufficiently to prevent the destructive end collisions of the rear cars when applying the brakes suddenly with full force.

George Westinghouse, Jr., contrived, and on March 29th, 1887, patented, in his patent No. 360,070, one means designed to accomplish this result. His invention consisted in a new "auxiliary valve," actuated by the piston of the old triple valve, to locally reduce the pressure in the air-pipe in cases of emergency, and thus quicken the application of the brakes upon the next succeeding car. This patented apparatus did not work satisfactorily on long trains, but *confessedly increased* instead of reducing their "shocks." He subsequently improved it by providing a supplementary chamber and special piston for operating the auxiliary, or emergency, valve, and obtained a patent for this improvement, No. 376,837, dated January 24, 1888. As thus improved it gave entire satisfaction, and has gone largely into use. Some 400,000 cars, according to the statements of complainants' counsel, having already been fitted up with it. Suits on both of these patents were subsequently brought in the Southern District of New York against the New York Air-Brake Company, who used the *auxiliary* emergency valve, the *supplementary chamber* and the *special piston* to operate it; and the Courts rightly sustained both patents and held the New York Air-Brake Company guilty of infringement. In their opinions in those cases the Court held that the invention of patent 360,070 consisted in the

new *auxiliary or emergency valve*, while that of patent 376,837 consisted in the new *supplementary chamber and piston* actuating that valve.

In 1888, George A. Boyden, one of your petitioners, invented another and radically different means for accomplishing the same result. He did not resort to the use of an "auxiliary" or special emergency valve at all, as did Mr. Westinghouse, but contrived to *make the old triple valve itself* produce the desired result, without the aid of Mr. Westinghouse's device or any mechanical equivalent thereof. For this invention, he received broad generic patents, dated August 16th, 1892, upon application filed September 30th, 1889. Your petitioners, Boyden Power Brake Company and Boyden Brake Company, became successively the owners of these Boyden patents, and have put the invention into successful practical use on a number of railroads.

On the 12th day of December, 1889, George Westinghouse, Jr., and The Westinghouse Air-Brake Company began suit against your petitioners in the United States Circuit Court for the District of Maryland, charging that said Boyden air-brakes infringe the *first, second and fourth* claims of said Westinghouse patent, No. 360,070. Several years were spent in getting the case ready for trial, and finally it was argued before His Honor Judge Morris, at Baltimore, in November, 1894. Judge Morris held, in substance, that the Boyden brake does not employ the auxiliary, or emergency, valve of the Westinghouse patent, and, therefore, does not infringe the *first and fourth* claims thereof; but that the *second* claim of said patent is entitled to cover *functional equivalents*, or, in other words, results, and, in that view of the case, that this claim was infringed. Your petitioners appealed; and, on the 11th day of November, 1895, the United States Circuit Court of Appeals, sitting at Richmond, Va., affirmed Judge Morris' decision on the *first and fourth* claims, but reversed it on the *second*, holding, in substance, that patents are not entitled to cover *functional* equivalents, but only *mechanical* equivalents, and that the Boyden apparatus

contains no mechanical equivalent of Mr. Westinghouse's auxiliary, or emergency, valve. In obedience to the mandate of the Circuit Court of Appeals, Judge Morris dismissed the Bill of Complaint in the Court below. The complainants then applied for a writ of *certiorari* from this Court to the Circuit Court of Appeals, under Act of March 3, 1891, and it was granted, thus bringing the whole controversy before this Court for review.

As the result of Judge MORRIS' decision, your petitioners were under injunction from the 25th day of April, 1895, to the 16th day of December, 1895, and were thereby subjected to heavy loss, damage and injury to their business.

The pendency of this suit during the long period from the filing of the Bill of Complaint till the decision of the Circuit Court of Appeals—six years—was also very disastrous to your petitioners' business. The railroad companies throughout the country were warned by the complainants not to buy your petitioners' air-brakes, and the great majority of them did not dare to buy while the litigation was still undecided. The complainants thus succeeded in making the mere fact of a pending suit operate substantially with the same effect as an injunction. After the decision of the Circuit Court of Appeals, your petitioners were for the period of about two months relieved from this interference with their business; but since this Honorable Court has granted the writ of *certiorari*, renewing and continuing the litigation after it was believed to have been ended, your petitioners again find their business ruinously obstructed and substantially stopped, so that, although clear of Judge MORRIS, injunction, they practically might as well be under it.

To increase the timidity of the railroads and ensure the destruction of your petitioners' business, the Westinghouse Company has recently adopted the policy of bringing suits against the railroads, charging them, in one case, with infringing said patent, No. 360,070, by allowing a single freight car equipped with your petitioners' air-brakes to be hauled over their tracks, although the car in question belonged to some other railroad. And thus it has come to pass

that, although by the unanimous judgment of the Circuit Court of Appeals for the Fourth Circuit, your petitioners have as clear a right to put out their air-brake as the Westinghouse Company has to put out its own, yet they have been for the long period of six years, and now are, prevented from so doing, while their adversary has been, and still is, reaping the entire profits of this vast business, even to the extent of declaring dividends of 40 per cent. per annum on a capital stock of \$5,000,000. Justice and equity demand that this condition of affairs shall not be allowed to continue one day longer than is absolutely unavoidable. Your petitioners respectfully submit that on this ground alone the hearing in this case should be advanced.

2. But, we respectfully submit, there is another and still stronger reason why it should be advanced.

Unless advanced, a decision could hardly be reached before the end of the year 1897, if, indeed, so early as that. But if the decision of this Court be delayed till the last half of 1897, then, even though it be in our favor, we shall be practically robbed of the entire value of our patents and our large and valuable business interests will have been irreparably damaged and all its substantial profits handed over the Westinghouse Air-Brake Company. For, by the Act of 1893, 27 Stat. at Large, p. 531, chap. 196, entitled

"An Act to promote the safety of employees and travelers upon railroads by compelling common carriers engaged in interstate commerce to equip their cars with automatic couplers and continuous brakes and their locomotives with driving-wheel brakes, and for other purposes,"—

all railroads engaged in interstate commerce must be fully equipped with power brakes on or before the first day of January, 1898, or suffer a heavy penalty. All freight cars may be said to be engaged in interstate commerce, as they go from one road to another, and practically wander all over the country, even although the railroad which owns them may be a short line lying within a single State. It is, therefore, imperatively necessary for every railroad in the country to

fully equip its cars with air-brakes prior to January 1, 1898. In fact, the railroads have for a long time been, and now are, actively endeavoring to comply with the provisions of said Act. The effect of the Act is, therefore, to compel the railroads to spend about \$32,000,000 within the next two years in providing their freight cars with air-brakes; and the effect of your Honors' refusal to advance this cause would be to give that entire business to the Westinghouse Company; and if your Honors' decision should finally be rendered in our favor, as we confidently expect it will be, it will give us the shadow and not the substance—the mine, after all the ore has been extracted by our adversaries.

Even if this condition of things had come about by natural causes, it would, we respectfully submit, appeal strongly to your Honors to advance and expedite the hearing of this cause; but when we consider that it is a situation forced upon us directly by the intervention of the legislative department of the Government, it would seem that the judicial department ought to give us what relief it can by advancing the hearing of our cause, to save us from a disaster which Congress certainly did not contemplate when it passed the act. The government has given us our patents; the Circuit Court of Appeals, whose decision in patent cases is ordinarily final, has unanimously declared our right to the free use of them; Congress has intervened to render that right practically worthless unless it can be exercised promptly; and this Honorable Court, by granting the writ of *certiorari*, has cut us off from the present enjoyment of that right, and jeopardized our chances of ever enjoying it, even though your Honors' decision should ultimately be in our favor. The only way in which relief can now come is by a speedy hearing and adjudication of the merits of our cause. If left to take the usual course, the injury to us will be irreparable.

3. The case is one of great public importance and interest; otherwise, under the repeated decisions of this Court, the writ of *certiorari* would not have been granted. The same reason of public importance which led to the

grant of the writ of certiorari by this Court leads equally to the advancement of the hearing; and, when supplemented as it is by the other potent considerations hereinabove referred to, and by the fact that justice, in this case of great public importance, will be absolutely denied unless a speedy trial can be had, it would seem to appeal with irresistible force.

The public importance of the case arises not merely from the great sum of money at stake, but from other facts as well. The use of air-brakes, by enabling the speed of freight cars to be doubled with safety, in effect nearly doubles the entire traffic capacity of the railroads of this country. They are also life-saving and property-saving devices of such public value that, as we have seen, Congress has taken the unusual course of making their immediate use imperative. The importance of such use on all the railroads of the country having thus been authoritatively declared by the National legislature, it is of great public importance that the Act of Congress should be faithfully complied with. But there are over 1,000,000 freight cars in use in this country, of which, during the eight years since these quick-action brakes came upon the market, less than 400,000 have been equipped therewith,—leaving over 600,000, and perhaps more than 700,000, to be equipped before January 1, 1898,—and it is doubtful if the Westinghouse Company, with all its facilities, can supply this demand within the next two years. It is, therefore, highly important to the public, and to the execution of this law, that your petitioners shall have their rights adjudicated at the earliest possible moment, to the end that, if found to be lawfully entitled to manufacture and sell the Boyden brake, as they believe will be the fact, they may be dismissed from this litigation in season to render the railroads effective aid in securing the required brake equipment within the time limited by Congress.

But even if the Westinghouse Company should be able within the next two years to furnish all the air-brakes necessary to fulfill the requirements of the Act of Congress,

still it is important to the public interests that there shall be a wholesome competition in the business, as will be the case if your petitioners are free to enter the field. Otherwise, the railroads, carriers of the United States mail, confronted on the one hand by an Act of Congress which compels them to provide these requirements by January 1st, 1898, and on the other hand by a company which is allowed to exercise the exclusive privilege of furnishing said equipments at prices controlled only by themselves, will be liable to be ground between the upper and lower millstones of corporate greed. The dividends of the Westinghouse Company show that these brakes can be made and sold at a handsome profit at prices far below those heretofore exacted, and it is obviously for the public interest that competition in this important field of industry should not be kept suppressed, nor an absolute monopoly continued any longer than is imperatively necessary.

4. Cases involving patents of great value, where, by reason of litigation, the patentee is practically excluded from the enjoyment of his invention for years after the grant of his patent, as in the present instance, present strong claims for an immediate adjudication, and for an advancement upon the calendar if necessary to that end. In the judgment of Congress, a seventeen-year monopoly is the proper reward for a meritorious inventor who has contributed to the promotion of the useful arts. Every day's delay in the final adjudication of such a case cuts off a day from the life of the inventor's protection. Your petitioners' patents have already been shortened to about thirteen years; and, if your Honors should not advance this hearing, they will be further shortened to about eleven years, commencing after the most important profits of the business will have been absorbed by the adversary who has caused the loss of one-third of the life of our patents.

5. Your petitioners stand before this Honorable Court with the legal presumption that they have the right to manufacture, sell and use the Boyden quick-action air-brake—a presumption arising out of the unanimous decision

of the Circuit Court of Appeals upon that question. Your petitioners' right to produce and vend these brakes is founded upon the fact that the Boyden brake is an invention wholly different from that of Mr Westinghouse, and in no legal or equitable sense an infringement of his patent. They do not question the validity of Mr. Westinghouse's patent, nor deny his right to the exclusive use of his invention till the end of the term. Their position is, that his patent must be construed as covering only his invention, and that it does not cover the production of the same result by other and different means which are not the mechanical equivalents of his means. Their interpretation of his patent is precisely the same as that adopted by His Honor, Judge LACOMBE, and by the Circuit Court of Appeals for the Second Circuit, in the case against the New York Air-Brake Company, referred to in the complainants' papers on the application for a *certiorari* in this case. In this construction of the Westinghouse patent, the Circuit Court of Appeals for the Fourth Circuit agreed with your petitioners and with Judge LACOMBE and the New York Circuit Court of Appeals, and directed the complainants' bill to be dismissed with costs. Your petitioners have never understood, and do not now understand, the decision of the Circuit Court of Appeals in this case as going beyond the question of infringement. It is true that there is, in the *opinion* of that Court, one expression intimating that the broad terms of the second claim are "fatal," which expression, read without reference to other parts of the opinion, might lead to the conclusion that the Court was disposed to hold said claim invalid; but your petitioners and their counsel have always understood that expression to mean "fatal, unless limited, by construction, to the invention made by Mr. Westinghouse," and in this view they are borne out by the fact that, in another part of the opinion, the Court discussed the effect of the words in the claim, "substantially as described," and held that they required the patent to be limited as above stated.

In the application for a *certiorari*, said expression, however, was cunningly removed from its context and held up

before this Court, apart from the rest of the opinion, as showing that there was a direct conflict between the judgments of the two Circuit Courts of Appeal, although counsel well knew that the validity of the Westinghouse patent was openly admitted by your petitioners and their counsel in their arguments and briefs used on the trial of the case at Richmond. How far this subtle proceeding may have influenced your Honors to grant the writ of *certiorari*, we do not know; but if it had any influence at all in that direction, an additional reason is thereby furnished for a speedy adjudication of the case, in order that the complainants may not profit by their own wrong, by which they have succeeded in again tying up your petitioners' business for an indefinite time.

6. The hearing and adjudication of the case will not impose upon your Honors a long and arduous labor. The points to be decided are but two in number, viz:

(a) Is the Westinghouse patent to be construed as limited to Mr. Westinghouse's auxiliary or emergency valve, as held by the Circuit Court in New York and the Circuit Courts of Appeals of the Second and Fourth Circuits; or, on the other hand, is it to be construed as covering a *result*, and as infringed by a structure which does not contain such auxiliary or emergency valve, as held by Judge Morris in Baltimore?

Your Honors have already decided the law of this question too many times to need much further consideration of it now.

(b) Is the Boyden combination the same in mode of operation and mechanical means as the Westinghouse combination; or, on the other hand, is it a new and different invention, accomplishing its result by other means and a different mode of operation, as unanimously held by the Circuit Court of Appeals for the Fourth Circuit, and substantially conceded even by Judge Morris in his opinion?

The solution of this question needs merely a thorough understanding of the two structures and of the Westinghouse patent.

No question of prior invention, anticipation, or public use, is raised, but simply the question of infringement. The case, therefore, involves no unusual amount of labor on your Honors' part. It can be heard and decided before the end of this term, without seriously interfering with the other business of the Court. To postpone it to October would use up about one-third of the time available to your petitioners under the Act of Congress above referred to.

Your petitioners are fully sensible of the great labor devolved upon this Court in the ordinary transaction of its business; and but for the turn that affairs have taken, and the pressure of the Act of Congress, which threaten to destroy their important and valuable interests, they would not ask your Honors to intervene in their behalf, but would await the regular call of the calendar, although thereby losing two years of the life of their patent protection and their business. Under existing circumstances, however, they have no recourse but to apply to your Honors for relief, which they feel should be awarded both on the ground of the public interests and for the prevention of the grievous wrongs which your petitioners are now suffering. It will be seen that, in the language of Rule 26, paragraph 7, the "circumstances" of your petitioners' case are "special and peculiar," and such as are never likely to arise again in any other case; so that, by granting this relief, in view of the peculiar effect of the Act of Congress referred to, no precedent will be established that will be liable to embarrass this Court in the future.

BOYDEN POWER BRAKE COMPANY. *

By G. A. BOYDEN, *President*.
C. B. MANN, *Secretary*.
W. WHITRIDGE, *Treasurer*.

And BOYDEN BRAKE COMPANY,

By G. A. BOYDEN, *President*.

LYSANDER HILL,

Counsel for Petitioners.

STATE OF MARYLAND, }
CITY OF BALTIMORE, } ss.

George A. Boyden, having been duly sworn, deposes and says: That he is one of the above-named petitioners; that he has read said petition, by him subscribed, and understands the contents thereof; and that the statements of facts therein contained are true to the best of his information and belief.

G. A. BOYDEN.

Subscribed and sworn to before me this 14th day of March, A. D. 1896.

GEO. E. TAYLOR,
Notary Public.



Subsequently, to wit, on November 16, 1896, this honorable Court made an order restoring the said causes to the calendar and directing a reargument thereof.

The effect of said order of November 16, 1896, is to restore said causes to their original position on the calendar as though they had not been advanced, unless a new order shall be made in pursuance of this motion.

The same reason for advancement and early hearing of said causes exist now that existed at the time of the previous motion to advance; and as said reasons are fully set forth in the petition of The Boyden Power Brake Co. then filed, a copy of said petition is hereto annexed.

An additional reason for an early re-assignment of said causes exists in the fact that while the technical matters of mechanics involved in the issues are fresh in the mind of the Court, it would perhaps avoid the necessity of re-arguing such matters in detail, and thereby lessen the labor of the Court, if the causes are again heard at an early date.

Since the making of the order of November 16, 1896, restoring the causes to the calendar, notice of this motion, to be made on November 30, 1896, has been given to counsel of record for the Westinghouse Air-Brake Company, as also notice that January 4, 1897, would be suggested to this honorable Court as an appropriate and convenient date to be assigned for the hearing of said causes, if this motion to advance the same be allowed.

LYSANDER HILL,
HECTOR T. FENTON,
MELVILLE CHURCH,

Of Counsel for Boyden Brake Co.

November 30, 1896.

SUPREME COURT OF THE UNITED STATES.

AIR-BRAKE CASES.

Memorandum on Behalf of the Boyden Company re Petition for Rehearing.

It is not our purpose to trouble the Court with an argument in reply to the petition for rehearing, and brief in support thereof, which are occupied with criticisms of the decision of the Court reached after three exhaustive arguments of the case. We deem it proper, however, to call attention to a matter of vital concern to defendants.

When the case came to the Court in the spring of 1896, the Court recognized that defendants were entitled to a prompt adjudication (see motion to advance). The particular reason was that Congress had fixed a short limit of time within which the railroads of the country were required to equip their freight cars with air-brakes. That time (though it has been extended by Congress) has nearly expired, and further prolongation of the uncertainty created by this litigation would be as advantageous to complainant, and as injurious to defendants, as a decision in favor of the former. Railroads will not equip their cars with brakes which, by a subsequent order of the Court, they may be required to strip off. Thus,

for nearly nine years, during which defendants have been pursued in this litigation, complainant has enjoyed a practical monopoly, while defendants have been deprived of all use of their patented devices.

On page 16 of complainant's brief, filed with the petition, is the statement that in 1896 there were over four hundred thousand Westinghouse brakes (which, at forty dollars each, the standard price, represents an income of over sixteen million dollars), while of defendant's brake there were less than five hundred.

A prolongation of the conditions to which this result has been due would be of incalculable injury to defendants. We therefore most earnestly beg the Court, if it be possible, that the petition for rehearing be disposed of before the adjournment of the Court.

Very respectfully,

ANTHONY POLLOK,
PHILIP MAURO,
Of Counsel for Defendants.



BLEED. THROUGH POOR COPY

99 & 116.

IN THE
Supreme Court of the United States
OCTOBER TERM, 1897.

Nos. 99 and 116.

WESTINGHOUSE AIR BRAKE COMPANY ET AL.
vs.
BOYDEN BRAKE COMPANY ET AL.

SUGGESTION OF COUNSEL AS TO RE-ARGUMENT.

*To the Honorable the Chief Justice and Associate Justices of the
Supreme Court of the United States:*

The parties to the above-entitled cause, in view of the fact that the said cause has twice been argued before this honorable Court, respectfully suggest that it may conduce to the convenience of the Court, as well as to that of the parties to the cause and their respective counsel, if to the Court it seems proper, that the Court would indicate, with as much particularity as is practicable, the points in said cause upon which the Court is desirous of hearing counsel in the re-argument that has been ordered.

The undersigned therefore respectfully unite in this sug-

gestion, and ask the Court to take such action hereon as to it may seem proper.

And as in duty.

BARTON & WILMER,

Of Counsel for Boyden Brake Co.

GEORGE H. CHRISTY,

FREDERIC H. BETTS,

Of Counsel for Westinghouse Air Brake Co.

MELVILLE CHURCH,

Of Counsel for Boyden Power Brake Co.

[Endorsed:] Case No. 16,137. Supreme Court U. S., October term, 1897. Term Nos., 99 and 116. Boyden Power Brake Co. *et al.*, app'ts, *vs.* Geo. Westinghouse, Jr., *et al.* Suggestion that Court indicate points on re-argument. Filed January 17, 1898.

WESTINGHOUSE *v.* BOYDEN POWER BRAKE
COMPANY.

BOYDEN POWER BRAKE COMPANY *v.* WEST-
INGHOUSE.

CERTIORARI TO THE CIRCUIT COURT OF APPEALS FOR THE FOURTH
CIRCUIT.

Nos. 116, 99. Argued March 10, 11, 1898. — Decided May 9, 1898.

The Boyden device for a fluid-pressure break is not an infringement of patent No. 360,070 issued to George Westinghouse, Jr., March 29, 1887, for a fluid-pressure automatic-brake mechanism.

This was a writ of certiorari to review a decree of the Circuit Court of Appeals, reversing a decree of the Circuit Court for the District of Maryland, which had sustained, in part, a bill filed by Westinghouse against the Boyden Power Brake Company for the infringement of patent No. 360,070, and from which decree both parties had taken an appeal to the Circuit Court of Appeals.

The patent in suit, which was issued March 29, 1887, to George Westinghouse, Jr., is for a fluid-pressure automatic-brake mechanism, the object of which is said in the speci-

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fication to be "to enable the application of brake-shoes to car-wheels by fluid pressure to be effected with greater rapidity and effectiveness than heretofore, more particularly in trains of considerable length, as well as to economize compressed air in the operation of braking, by utilizing in the brake-cylinders the greater portion of the volume of air which in former practice was directly discharged into the atmosphere."

"To this end my invention, generally stated, consists in a novel combination of a brake-pipe, an auxiliary reservoir, a brake-cylinder and a 'triple-valve' device, governing, primarily, communication between the auxiliary reservoir and the brake-cylinder, and, secondarily, communication directly from the brake-pipe to the brake-cylinder."

There follows here a description of the Westinghouse automatic brake as theretofore used, its mode of operation, and the defects or insufficiencies which attended its application to long trains, in the following language :

"In the application of the Westinghouse automatic brake as heretofore and at present commonly in use, each car is provided with a main air-pipe, an auxiliary reservoir, a brake-cylinder and a triple-valve, the triple-valve having three connections, to wit, one to the main air-brake pipe, one to the auxiliary reservoir and one to the brake-cylinder. The main air-pipe has a stop-cock at or near each of its ends, to be opened or closed as required, and is fitted with flexible connections and couplings for connecting the pipes from car to car of a train, so as to form a continuous line for the transmission of compressed air from a main reservoir supplied by an air-pump on the engine. When the brakes are off or released, but in readiness for action upon the wheels of the train, the air which fills the main reservoir and main air-pipes has a pressure of from sixty-five to seventy-five pounds to the square inch, and by reason of the connections referred to the same pressure is exerted in the casings of the triple-valves on both sides of their pistons and in the auxiliary reservoirs connected therewith. At the same time passages called 'release-ports' are open from the brake-cylinders to the atmosphere. When it is desired to apply the brakes, air is

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allowed to escape from the main air-pipes through the engineer's valve, thereby reducing the pressure in the main air-pipes, whereupon the then higher pressure in the auxiliary reservoirs moves the pistons of the triple-valves, so as to first close the passages from the triple-valves to the brake-pipe and at the same time close the release-ports of all the brake-cylinders, and then open the passages from the auxiliary reservoirs to the brake-cylinders, the pistons of which are forced out by the compressed air thereby admitted to the brake-cylinders, applying the brakes by means of suitable levers and connections, all of which mechanism is fully shown in various letters patent granted to me."

"The application of the brakes with their full force has heretofore required a discharge of air from the main pipe sufficient to reduce the pressure in said pipe below that remaining in the auxiliary reservoir after the brakes have been fully applied, and it has been found that, while the brakes are sufficiently quick in action on comparatively short trains, their action on long trains of from thirty to fifty cars, which are common in freight service under present practice, is in a measure slow, particularly by reason of the fact that all the air required to be discharged from the main pipe to set the brakes must travel from the rear of the train to a single discharge opening on the engine. This discharge of air at the engine has not only involved a serious loss of time in braking, but also a waste of air. Under my present invention a quicker and more efficient action of the brakes is obtained, and air which has been heretofore wasted in the application of the brakes is almost wholly utilized to act upon the brake-pistons."

After a detailed description of the invention, an important feature of which is a triple-valve, (hereinafter more fully explained in the opinion,) with references to the accompanying drawings, the specification proceeds to state that, "so far as the performance of its preliminary function in ordinary braking is concerned—that is to say, effecting the closure of communication between the main-air pipe and the auxiliary reservoir, and the opening of communication between the aux-

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iliary reservoir and the brake-cylinder in applying the brakes, and the reverse operations in releasing the brakes—the triple-valve 10 accords substantially with that set forth in letters patent of the United States No. 220,556, granted and issued to me October 14, 1879, and is not, therefore, saving as to the structural features by which it performs the further function of effecting the direct admission of air from the main air-pipe to the brake-cylinder, as presently to be described, claimed as of my present invention. Certain of its elements devised and employed by me prior thereto will, however, be herein specified, in order to render its construction and operative relation to other members of the brake mechanism fully intelligible.”

After a further reference to the drawings he again states that “so far as hereinbefore described, the triple-valve accords in all substantial particulars with and is adapted to operate similarly to those of my letters patent Nos. 168,359, 172,064 and 220,556, and, in order that it may perform the further functions requisite in the practice of my present invention, it is provided with certain additional members, which will now be described.” These additional members, which are said to be for the purpose of effecting the admission of air directly from the main air-pipe to the brake-cylinder when it is desired to apply the brakes with great rapidity and full force, consist of (1) a passageway through which air can be admitted directly from the main air (or train) pipe to the brake-cylinder, without passing through the auxiliary reservoir; and, (2) an auxiliary valve in connection with such passage, that, when the triple-valve piston makes a short or preliminary movement, the passageway direct from the train-pipe to brake-cylinder, controlled by said valve, will not be opened, while, in the event of a long or full movement of the piston, or “further traverse,” as it is called, such direct passageway will be thrown wide open to the admission of train-pipe air, and the brake-cylinder will be rapidly filled thereby.

After describing the auxiliary sliding valve 41 and its connections, as well as the operation of the device in ordinary (non-emergency) cases of checking the speed of or stopping trains, already fully provided for in previous patents, he pro-

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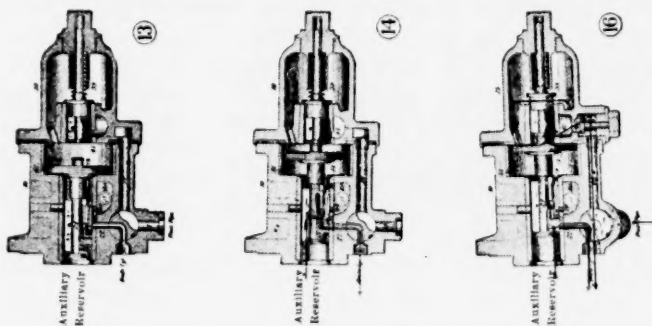
ceeds to state its operation in cases of emergency which the patent was specially designed to cover, as follows:

"In the event, however, of its becoming necessary to apply the brakes with great rapidity and with their greatest available force, the engineer, by means of the valve at his command, instantly discharges sufficient air from the front end of the main air-pipe to effect a sudden reduction of pressure of about twenty pounds per square inch therein, whereupon the piston 12 of the triple-valve is forced to the extreme limit of its stroke in the direction of the drain-cup 19, carrying with it the stem 36 and auxiliary slide-valve 41, which instantly uncovers the port 42 and discharges air from the main air-pipe through the opening of the check-valve 49 and the passages 46 and 48 to the brake-cylinder, and, each car being provided with one of these devices, it will be seen that they are successively moved with great rapidity, there being practically on a train of fifty cars fifty openings for discharging compressed air from the main pipe instead of the single opening heretofore commonly used. Not only is there a passage of considerable size opened from the brake-pipe on each car, whereby the pressure is more quickly reduced, but the air so discharged is utilized in the performance of preliminary work, it being found in practice that the air so taken from the pipe will exert a pressure of about twenty-five pounds in the brake-cylinders. When the piston 12 arrives at the extremity of its stroke as above specified, the supplemental port 35 of the slide-valve 14 is brought into communication with the port 33 and passages 22 and 16, which serves to discharge the reservoir-pressure into the brake-cylinder, thereby augmenting the pressure already exerted in the brake-cylinder by the air admitted from the main air-pipe. Upon the reduction of the pressure in the main air-pipe below that in the brake-cylinders, as by the breaking in two of the train, the check-valve 49 closes communication between the passages 46 and 18, thereby preventing the return of the air from the brake-cylinder to the main air-pipe. The feed-opening for the admission of air from the auxiliary reservoir to the brake-cylinder is purposely made of comparatively small diameter, it having been determined

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by experiment that the initial application of the brakes should not be made with maximum force, and this opening may be made of such size as to apply the brakes exactly in accord with the requirements of the most efficient work."

"In using the terms 'triple-valve' and 'triple-valve device' I refer to a valve device, however specifically constructed, having a connection with the main air or brake-pipe, another with an auxiliary reservoir or chamber for the storage of power, and another with a brake-cylinder or its equivalent for the utilization of the stored power, and with a release or discharge passage for releasing the operative power from the brake-cylinder, whether the valves governing these passages or connections are arranged in one or more cases and are moved by a piston or its equivalent or by a series of pistons or their equivalents, there being numerous examples in the art of constructions varying materially in appearance whereby these functions are performed, both in plenum and vacuum brake mechanisms."



The above drawings are somewhat clearer than those annexed to the patent, and exhibit the triple-valve and its connections in three positions, viz., No. 13, Released or "Brakes Off;" No. 14, Ordinary Service Application, and No. 16, "Quick Action" Position.

The only claims of the patent alleged to have been infringed are the first, second and fourth, which read as follows:

"1. In a brake mechanism, the combination of a main air-

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pipe, an auxiliary reservoir, a brake-cylinder, a triple-valve and an auxiliary-valve device, actuated by the piston of the triple-valve and independent of the main valve thereof, for admitting air in the application of the brake directly from the main air-pipe to the brake cylinder, substantially as set forth."

"2. In a brake mechanism, the combination of a main air-pipe, an auxiliary reservoir, a brake-cylinder, and a triple-valve having a piston whose preliminary traverse admits air from the auxiliary reservoir to the brake-cylinder, and which by a further traverse admits air directly from the main air-pipe to the brake-cylinder, substantially as set forth."

"4. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston-stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere, respectively, and an auxiliary valve actuated by the piston-stem and controlling communication between passages leading to connections with a main air-pipe and with the brake-cylinder, respectively, substantially as set forth."

The joint and several answer of the Boyden Brake Company and the individual defendants admitted that such company was engaged in manufacturing and selling a fluid-pressure brake, but denied that the same was an infringement upon complainants' patent, and also denied that Westinghouse was the original inventor of the mechanism covered by the patent, and alleged that an apparatus, substantially identical in character, had been previously granted Westinghouse, March 5, 1872, (No. 124,404,) and that a like apparatus was previously described in the following patents issued to Westinghouse, viz.: No. 138,827, May 13, 1873; No. 144,006, October 28, 1873; No. 168,359, October 5, 1875; No. 172,064, January 11, 1876; No. 220,556, October 14, 1879, and also in three patents to other parties, not necessary here to be specifically mentioned.

The answer further denied any infringement of the first, fourth and fifth claims of the patent sued upon, (No. 360,070.) and, with respect to the second claim, averred the same to be

Counsel for Westinghouse.

invalid because the combination of parts therein named is inoperative to perform and incapable of performing the function set forth in said claim ; and that, if the said claim be considered merely as the combination of parts therein set forth, and without reference to the function described as performed by it, it is invalid for the reason that the same combination of parts is shown in most of the prior patents above cited, and has been publicly used by the complainants for a long time prior to the date of the said letters patent No. 360,070.

The answer further averred the claim to be uncertain and ambiguous, and if the functions recited by it are construed as amplifying the description of the combination to distinguish this combination from that shown in the prior patents, "then the defendants say that the said claim is anticipated by the prior letters patent issued to George A. Boyden on June 26, 1883, for the reason that air-brake valves made in accordance with the last mentioned patent embody the same combination of parts, and will perform the same functions, and operate in substantially the same manner as stated in said second claim."

Upon a hearing in the Circuit Court upon the pleadings and proofs, that court was of opinion that the second claim was valid, and had been infringed, but that defendants had not infringed claims one and four, and as to those the bill was dismissed. 66 Fed. Rep. 997. From the decree entered in pursuance of this opinion both parties appealed to the Court of Appeals for the Fourth Circuit, which affirmed the action of the Circuit Court with respect to the first and fourth claims, but reversed it with respect to the second claim, and dismissed the bill. 25 U. S. App. 475. Whereupon complainants applied for and were granted a writ of certiorari.

Full copies of the principal Westinghouse patents are printed in *Westinghouse Brake Co. v. N. Y. Brake Co.*, 26 U. S. App. 248, and of the Boyden patents in the report of this case in 25 U. S. App. 475.

Mr. George H. Christy and *Mr. Frederic H. Betts* for Westinghouse. *Mr. J. Snowden Bell* and *Mr. Bernard Carter* were on their brief.

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Mr. Philip Mauro and *Mr. Lysander Hill* for the Boyden Power Brake Company. *Mr. Hector T. Fenton*, *Mr. Melville Church* and *Mr. Anthony Pollok* were on their brief.

MR. JUSTICE BROWN, after stating the case, delivered the opinion of the court.

The history of arresting the speed of railway trains by the application of compressed air is one to which the records of the Patent Office bear frequent witness, of a gradual progress from rude and imperfect beginnings, step by step, to a final consummation, which, in respect to this invention, had not been reached when the patent in suit was taken out, and which, it is quite possible, has not been reached to this day. It is not disputed that the most important steps in this direction have been taken by Westinghouse himself.

The original substitution of the air-brake for the old hand-brake was itself almost a revolution, but the main difficulty seems to have arisen in the subsequent extension of that system to long trains of freight cars, in securing a simultaneous application of brakes to each of perhaps forty or fifty cars in such a train, and finally in bringing about the instantaneous as well as simultaneous application of such brakes in cases of emergency, when the speediest possible stoppage of the train is desired to avoid a catastrophe.

Patent No. 88,929, issued April 13, 1869, appears to have been the earliest of the Westinghouse series. This brake, known as the *straight-air brake*, consisted of an air-compressing pump, operated by steam from the locomotive boiler, by which air was compressed into a reservoir, located under the locomotive, to a pressure of about eighty pounds to the square inch. This reservoir, being still in use, is now known as the main reservoir. From this reservoir an air-pipe, usually called the train-pipe, led into the cab, where the supply of air was regulated by an "engineer's valve," thence down and back under the tender and cars, being united between the cars by a flexible hose with metal couplings, rendering the train-pipe continuous. These couplings were automatically

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detachable; that is, while they kept their grip upon each other under the ordinary strains incident to the running of the train, they would readily pull apart under unusual strains, as when the car coupling broke and the train pulled in two.

From the train-pipe of each car, a branch pipe connected with the forward end of a cylinder, called the "brake-cylinder," which contained a piston, the stem of which was connected with the brake levers of the car. This piston was moved and the brakes applied, by means of compressed air admitted through the train-pipe and its branches, into the forward end of the brake-cylinder. When the brakes were to be applied, the engineer opened his valve, admitted the compressed air into the train-pipes and brake-cylinders, whereby the levers were operated and the brakes applied. To release the brakes, he reversed the valve, whereby the compressed air escaped from the brake-cylinders, flowed forward along the train-pipe to the escape port of the engineer's valve, thence into the atmosphere. Upon the release of the compressed air, the pistons of the brake-cylinders were forced forward again by means of springs, and the brake-shoes removed from the wheels. By means of this apparatus, the train might be wholly stopped or slowed down by a full or partial application of the brakes. As between a full stop and a partial stop, or slow speed, there was only a question of the amount of air to be released from the main reservoir. The validity of this patent was sustained by the Circuit Court for the Northern District of Ohio, Mr. Justice Swayne and Judge Welker sitting, in *Westinghouse v. The Air Brake Company*, 9 Official Gazette, 538. The court said, in its opinion, that while Westinghouse was not the first to conceive the idea of operating railway brakes by air pressure, such fact did not detract at all from his merits or rights as a successful inventor; that the new elements introduced by him "fully substantiated his pretensions as an original and meritorious inventor, and entitled him as such to the amplest protection of the law;" and that it appeared from the record and briefs that he was the first to put an air-brake into successful actual use.

While the application of this brake to short trains was

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reasonably successful, the time required for the air to pass from the locomotive to the rear cars of a long train (about one second per car) rendered it impossible to stop the train with the requisite celerity, since in a train of ten cars it would be ten seconds before the brakes could be applied to the rear car, and to a freight train of fifty cars nearly a minute. While the speed of the foremost car would be checked at once, those in the rear would proceed at unabated speed, and in their sudden contact with the forward cars would produce such shocks as to often cause damage. As a train moving at the rate of fifty miles an hour makes over seventy feet per second, a train of fifty cars would run half a mile before the brakes could be applied to the rear car. So, too, if the rear end of the train became detached from the forward end by the rupture of the train-pipe or couplings, the brakes could not be applied at all, since the compressed air admitted to the train-pipe by opening the engineer's valve would escape into the atmosphere without operating the brakes, or if the brakes were already applied, they would be instantly released when such rupture occurred.

The first step taken toward the removal of these defects resulted in what is known as "the *automatic brake*," described first in patent No. 124,404 in a crude form, and, after several improvements, finally culminating in patent No. 220,556 of 1880. The salient features of this brake were an auxiliary reservoir beneath each car for the reception and storage of compressed air from the main reservoir, and a triple-valve, so called, automatically controlling the flow of compressed air in three directions, by opening and closing, at the proper times, three ports or valve openings, viz.: 1. A port or valve known as the "feeding-in valve" from the train-pipe to the auxiliary reservoir, allowing the auxiliary reservoir to fill so as to be ready when the brakes were applied; 2. A port or valve from the auxiliary reservoir to the brake-cylinder, which allowed a flow of compressed air to apply the brakes, and was called the "main valve;" 3. A port or valve from the brake-cylinder to the open air, denominated the "release-valve," to be opened when it was desired to release the brakes.

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The operation of these valves was as follows: Before the train starts, compressed air from the main reservoir is permitted to flow back through the train-pipe, and through valve No. 1, for the purpose of charging the auxiliary reservoir beneath each car with a full working pressure of air. When it is desired to apply the brakes, the engineer's valve is shifted, and the air in the train-pipe is allowed to escape into the atmosphere at the engine. Thereupon the compressed air in the auxiliary reservoir closes valve No. 1, leading to the train-pipe, and opens the main valve No. 2, from the auxiliary reservoir to the brake-cylinder, whereby the piston of that cylinder operates upon the brake-levers and applies the brakes. By this use of the auxiliary reservoirs a practically simultaneous application of the brakes is secured for each car. This application of the brakes is secured, not by direct application of compressed air from the engine through the train-pipe, but by a reverse action, whereby the air is allowed to escape from the train-pipe toward the engine, the pressure being applied by the air escaping from the auxiliary reservoirs. It also results that, if a train should pull in two, or a car become detached, the same escape of air occurs, the same action takes place automatically at the broken part, and the same result follows by the escape of the compressed air through the separated couplings. When it is desired to release the brakes, the engineer's valve is again shifted, and the compressed air not only opens valve No. 1 from the train-pipe to the auxiliary reservoir, but valve No. 3 from the brake-cylinder to the open air, which allows the air from the brake-cylinder to escape and thus release the brake.

From this description it will be seen that the action of the automatic brake was, in fact, the converse of that of the straight air-brake, and that the result was to obviate the most serious defects which had attended the employment of the former.

This automatic brake appears, in its perfected form, in patent No. 220,556, although this patent was but the culmination of a series of experiments, each successive step in which appears in the prior patents. Thus in patent No. 124,404, (1872),

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is introduced the auxiliary reservoir beneath each car in connection with a double line of brake-pipes and a single cock with suitable ports for charging the reservoir and for operating the brakes — a device which was obviously the foundation of the triple-valve which first made its appearance in patent No. 141,685, (1873,) in which the main valve, which admitted air from the auxiliary reservoir to the brake-cylinder, was of the poppet form; and as a poppet-valve can govern only one port, separate valves had to be provided for feeding in the air from the train-pipe to the auxiliary reservoir, and for discharging the air from the brake-cylinder to release the brakes. In subsequent patents, No. 144,006, (1873,) and No. 163,242, (issued in 1875 to C. H. Perkins and assigned to Westinghouse,) Mr. Westinghouse improved upon his prior devices by substituting a sliding-piston valve for the poppet form of main valve previously used by him. This enabled the piston to perform the feed-valve function of admitting air from the train-pipe to the auxiliary reservoir; the main-valve function of admitting air from the auxiliary reservoir to the brake-cylinder to apply the brakes, and the release-valve function of discharging the air from the cylinder to release the brakes. In patent No. 168,359, (1875,) a piston actuating a slide-valve was substituted for the piston-valve, and, after a series of experiments, which did not seem to have been successful, he introduced into patent No. 217,838 the idea of venting the train-pipe, not only at the locomotive, but also under each car, in order to quicken the application of the brakes. Prior to this time, "when the engineer desired to apply his brakes with full force he operated the valve at the engine and opened the port wide, letting the compressed air out of the train-pipe at the locomotive, then its only vent. The air, as before said, had to travel from the rear cars along the cars forward to the engine before it could lessen the pressure of the train-pipe air, . . . and before the brake-cylinder could be operated with air from the auxiliary reservoirs. In a train of fifty cars it would have to travel nearly half a mile to get out at the engine." He embodied in patent No. 220,556, (1879,) the most complete form of the automatic brake, and as stated by the

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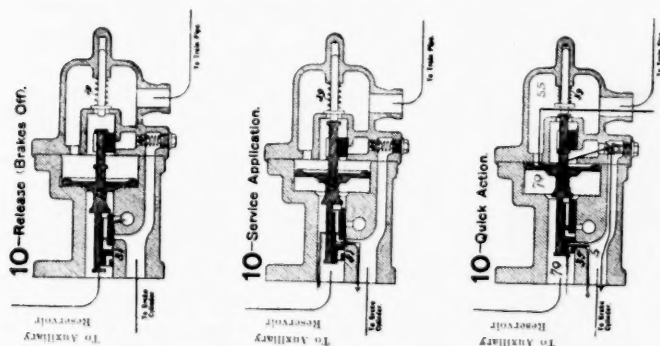
court below, "the ordinary work of braking was performed by a partial traverse of its chamber by the triple-valve piston, graduated according to the purpose desired, at the will of the engineer, and emergency work was done by an extreme traverse of the piston to the end of its chamber."

While the automatic brake had thus obviated the most important defects of the old or straight air-brake, and come into general use upon passenger trains throughout the country, it was found, in practice upon long freight trains, that the air from the auxiliary reservoirs did not act with sufficient promptness upon the brakes of the rear cars, where a particularly speedy action was required, and that it would be necessary to devise some other means for cases of special emergency. In the business of transporting freight over long distances, the tendency has been in the direction of increasing the load by using stronger and heavier cars and larger locomotives. Upon a long train of this kind, composed of thirty to fifty cars, a demand was made for quicker action in cases of emergency than had yet been contemplated, although for ordinary work, such as checking the speed of a train while running, holding it at a slow speed on a down grade, and also for making the ordinary station stops, the automatic brake was still sufficient, and produced satisfactory results even in the equipment of long and heavy trains. But however effective for ordinary purposes, the automatic brake did not sufficiently provide for certain emergencies, requiring prompt action, and, therefore, failed in a single important particular.

Upon examination of these defects it was found that they could only be remedied by securing, (1) in cases of emergency, a more abundant discharge of compressed air into the brake-cylinder; and (2) an escape of air near to each triple-valve without requiring the escaping air to travel all the way back to the engine. The latter device having been already embodied in patent No. 217,838, these features Mr. Westinghouse introduced into the patent in suit, by which a passage was opened directly from the train-pipe filled from the main reservoir on the engine, to the brake-cylinder through which, in cases of emergency, the train-pipe air, instead of being dis-

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charged into the atmosphere, could pour directly from the train-pipe into the brake-cylinder. This operation resulted in charging the brake-cylinder and applying the brakes more quickly than before, and also, by reason of the fact that the filling of the brake-cylinder from the train-pipe on one car made what was, in effect, a local vent for the release of pressure sufficient to operate the valve on the next car behind, each successive valve operated more quickly than when a diminution of pressure was caused by an escape of air only at the locomotive. The direct passage of the air from the train-pipe to the brake-cylinder was effected by a valve (41), colored red in the above diagrams, which is never opened except in cases of emergency. In ordinary cases, when the brakes are desired to be applied, sufficient air is released from the train-pipe to open the passage from the auxiliary reservoir to the brake-cylinder by what is called a preliminary traverse of the piston (12), but when a quick action is required sufficient air is drawn from the train-pipe, not only to open this passage, but by a further traverse of the piston, to shove valve 41 off its port, and introduce air directly from the train-pipe to the brake-cylinder, as shown in the following drawings.



In the foregoing skeleton drawings, from which all details of construction, and all figures of reference, not necessary for a clear understanding of the structure, are omitted, the

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essential parts are colored, so that their changes of position in the different stages of action can be easily followed.

The access of train-pipe air is shown located at the right end of the structure, instead of the left, (as in the patent drawings,) simply for greater clearness. Its course from the train-pipe to the auxiliary cylinder is through the small port above the upper arm of the piston 12.

The "main valve" of the triple is *black*. Its office is to admit auxiliary reservoir air to brake-cylinder.

The "quick-action" valve is colored *red*. Its office is to admit *train-pipe air* to brake-cylinder.

The release port is colored *green*. Its office is to discharge air from brake-cylinder, in releasing the brakes.

There is also shown in *yellow* what is known as the graduating valve, the function of which will be hereafter explained. As at present used, the triple-valve is in reality a quadruple-valve.

The flow or movement of air, in the several positions of the structure is also shown by colored lines and arrows, viz.:

Air released from brake-cylinder to open air by *green* arrow.

Air flowing from auxiliary reservoir to brake-cylinder, in "service" application of the brakes, by *red* line. And air flowing from train-pipe to brake-cylinder in "quick-action" application, by *blue* line.

This patent, although it introduced a novel feature into the art, does not seem to have been entirely successful in its practical operation, since in October of the same year an improvement was patented, No. 376,837, with the object of still further increasing the rapidity of action. As observed by the District Judge in this connection, "the success of this improved device, No. 376,837, has demonstrated that the invention, by which the further traverse of the triple-valve piston beyond the extent of the traverse required for the ordinary application of the brakes, is made to admit a large volume of train-pipe air directly to the brake-cylinder, was one of great importance. The proofs show that a quick-action automatic brake, which would give the results which this brake has accomplished, was eagerly

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sought after by inventors and car builders, and all had failed until Westinghouse discovered that it could be done by this mode of operation."

We are now in position to take up the several claims of the patent in suit, and their defences thereto. It may be stated generally that the position of complainants in this connection is, that the novel feature of this patent, in respect to which they are entitled to be protected, is the opening of a passage directly from the train-pipe to the brake-cylinder, without passing through the auxiliary reservoir and without reference to the means by which such passageway is controlled. Defendant's theory is that they are limited to such passageway when governed by the auxiliary valve 41, a device which, although of no utility as arranged in the patent in suit, became afterwards exceedingly useful when further combined with the supplementary piston shown in patent No. 376,837. The further inference is that, as they do not use the auxiliary valve of this patent, they cannot be held liable as infringers.

Complainants' case must rest either upon the theory that the admission of compressed air directly from the train-pipe to the brake-cylinder is patentable as a function, or that the means employed by the defendants for that purpose are a mechanical equivalent for the auxiliary valve 41, described in the patent.

1. The first theory is based upon the second claim, which is "in a brake mechanism, the combination of a main air-pipe, an auxiliary reservoir, a brake-cylinder and a triple-valve having a piston, whose preliminary traverse admits air from the auxiliary reservoir to the brake-cylinder, and which by a further traverse admits air directly from the main air-pipe to the brake-cylinder, substantially as set forth."

In the construction of this claim, the District Judge was of opinion that it was broad enough to cover other devices in which air was admitted directly from the train-pipe to the brake-cylinder by the further traverse of the piston actuating a valve admitting such air, and that the defendants could not exculpate themselves from the charge of infringement, from the fact that in their device the train-pipe air was admitted

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through the triple-valve chamber, and not through a by-passage, nor by the fact that in their device the further traverse of the piston opens the main valve in a special manner, which produces the same result, but does not make use of a separate auxiliary valve.

Upon the other hand, the Circuit Court of Appeals held that "the transmission of train-pipe air and auxiliary reservoir air simultaneously to the brake-cylinder is a result of [or] function, and is not patentable;" that "the means by which this or any other result or function is accomplished may be many and various, and if these several means are not mechanical equivalents, each of them is patentable." It was of opinion that when the second claim, "in its language describing the action of that device, failed to describe any means by which the extreme traverse of the piston produced it, declaring merely that the piston, 'by a further traverse, admits air directly from the main air-pipe to the brake-cylinder,' it was fatally defective, claiming only a result which is public property, and not identifying the specific means (his own property) by which the result is achieved."

It is true, as observed by the Court of Appeals, that the further traverse of the piston for use in cases of emergency had been shown in prior patents, but it had never been employed for the purpose of admitting air directly from the main air-pipe to the brake-cylinder until the patent in suit was taken out.

The claim in question is, to a certain extent, for a function, viz., the admission of air directly from the train-pipe to the brake-cylinder, and is only limited to such function when performed by the further traverse of the piston of the triple-valve. This limitation, however, does not obviate the objection that the means are not fully and specifically set forth for the performance of the function in question.

The difficulty we have found with this claim is this: That, if it be interpreted simply as a claim for the function of admitting air to the brake-cylinder directly from the train-pipe, it is open to the objection, held in several cases to be fatal, that the mere function of a machine cannot be patented.

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This rule was clearly laid down in the leading case of *Corning v. Burden*, 15 How. 252, in which Mr. Justice Grier, delivering the opinion of the court, drew the distinction between such processes as were the result or effect of "chemical action, by the operation or application of some element or power of nature, or of one substance to another," and the mere result of the operation of a machine, with regard to which he says:

"It is for the discovery or invention of some practicable method or means of producing a beneficial result or effect that a patent is granted, and not for the result or effect itself. It is when the term 'process' is used to represent the means or method of producing a result that it is patentable, and it will include all methods or means which are not effected by mechanism or mechanical combinations.

"But the term 'process' is often used in a more vague sense, in which it cannot be the subject of a patent. Thus we say that a board is undergoing the process of being planed, grain of being ground, iron of being hammered or rolled. Here the term is used subjectively or passively as applied to the material operated on, and not to the method or mode of producing that operation, which is by mechanical means, or the use of a machine, as distinguished from a process."

"In this use of the term it represents the function of a machine, or the effect produced by it on the material subjected to the action of the machine. But it is well settled that a man cannot have a patent for the function or abstract effect of a machine, but only for the machine which produces it."

In the subsequent case of *Burr v. Duryee*, 1 Wall. 531, 570, Mr. Justice Grier laid down the same principle as follows:

"The patent act grants a monopoly 'to any one who may have discovered or invented any new and useful art, machine, manufacture or composition of matter.' . . . The law requires that the specification 'should set forth the principle and the several modes in which he has contemplated the application of that principle, or character by which it may be distinguished from other inventions, and shall particularly point out the part, improvement or combination which he claims as

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his own invention or discovery.' We find here no authority to grant a patent for a 'principle' or 'a mode of operation,' or an *idea*, or any other abstraction. A machine is a concrete thing, consisting of parts, or of certain devices and combination of devices. The principle of a machine is properly defined to be its mode of operation, or that peculiar combination of devices which distinguishes it from other machines. A machine is not a principle or an idea. The use of ill defined abstract phraseology is the frequent source of error. It requires no great ingenuity to mystify a subject by the use of abstract terms of indefinite or equivocal meaning. Because the law requires a patentee to explain the mode of operation of his peculiar machine, which distinguishes it from others, it does not authorize a patent for 'a mode of operation as exhibited in the machine.' Much less can any inference be drawn from the statute, that an inventor who has made an improvement in a machine, and thus effects the desired result in a better or cheaper manner than before can include all previous inventions and have a claim to the whole art, discovery or machine which he has improved. All others have an equal right to make improved machines, provided they do not embody the same, or substantially the same devices, or combination of devices, which constitute the peculiar characteristics of the previous invention."

So also in *Fuller v. Yentzer*, 94 U. S. 288, this court, speaking through Mr. Justice Clifford, said :

"Patents for a machine will not be sustained if the claim is for a result, the established rule being that the invention, if any, within the meaning of the Patent Act, consists in the means or apparatus by which the result is obtained, and not merely in the mode of operation independent of the mechanical devices employed; nor will a patent be held valid for a principle or for an idea, or any other mere abstraction."

Most of the prior authorities upon this subject are reviewed in the recent case of *Risdon Locomotive Works v. Medart*, 158 U. S. 68, in which it was also held that a valid patent could not be obtained for a process which involved nothing more than the operation of a piece of mechanism, or the func-

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tion of a machine. See also to the same effect *Wicke v. Ostrum*, 103 U. S. 461, 469. These cases assume, although they do not expressly decide, that a process to be patentable must involve a chemical or other similar elemental action, and it may be still regarded as an open question whether the patentability of processes extends beyond this class of inventions. Where the process is simply the function or operative effect of a machine, the above cases are conclusive against its patentability; but where it is one which, though ordinarily and most successfully performed by machinery, may also be performed by simple manipulation, such, for instance, as the folding of paper in a peculiar way for the manufacture of paper bags, or a new method of weaving a hammock, there are cases to the effect that such a process is patentable, though none of the powers of nature be invoked to aid in producing the result. *Eastern Paper Bag Co. v. Standard Paper Bag Co.*, 30 Fed. Rep. 63; *Union Paper Bag Machine Co. v. Waterbury*, 39 Fed. Rep. 389; *Travers v. Am. Cordage Co.*, 64 Fed. Rep. 771. This case, however, does not call for an expression of our opinion upon this point, nor even upon the question whether the function of admitting air directly from the train-pipe to the brake-cylinder be patentable or not, since there is no claim made for an independent process in this patent, and the whole theory of the specification and claims is based upon the novelty of the mechanism.

But if the second claim be not susceptible of the interpretation that it is simply for a function, then the performance of that function must be limited to the particular means described in the specification for the admission of air from the train-pipe to the brake-cylinder. This we understand to be the theory of the defendants, and this raises the same question which is raised under the first and fourth claims, whether defendants' device contains the auxiliary valve of the Westinghouse patent, or its mechanical equivalent.

In this view, it becomes unnecessary to express an opinion whether the second claim be valid or not, since in the aspect of the case most favorable to the complainants, it is necessary to read into it something which is not found there, or, in the

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language of complainants' brief, "to refer back to the specification; not, it is true, for a slavish adoption of the identical instrumentalities therein described, but for the understanding of the essential and substantial features of the means therein illustrated." In thus reading the specification into the claim, we can adopt no other construction than to consider it as if the auxiliary valve were inserted in the claim in so many words, and then to inquire whether the defendants make use of such valve, or its mechanical equivalent.

There are two other facts which have a strong bearing in the same connection, and preclude the idea that this can be interpreted as a claim for a function, without reading into it the particular device described in the specification.

One of these is that the claim is for a triple-valve device, etc., for admitting air from the main air-pipe to the brake-cylinder, "substantially as set forth." These words have been uniformly held by us to import into the claim the particulars of the specification, or, as was said in *Seymour v. Osborne*, 11 Wall. 516, 547, "where the claim immediately follows the description of the invention, it may be construed in connection with the explanations contained in the specifications, and where it contains words referring back to the specifications, it cannot be properly construed in any other way." In that case it was held that a claim which might otherwise be bad, as covering a function or result, when containing the words "substantially as described," should be construed in connection with the specification, and when so construed was held to be valid. To the same effect is *The Corn Planter Patent*, 23 Wall. 181, 218.

Again, it appears from the file-wrapper and contents, that in his original application Mr. Westinghouse made a broad claim for the admission of air directly from the main air-pipe to the brake-cylinder, which was rejected upon reference to a prior patent to Boyden, No. 280,285, and that on January 19, 1887, his attorney wrote the Patent Office in the following terms:

"It is respectfully submitted that while the Boyden patent No. 280,285 referred to, shows that what the inventor terms

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'an always-open one-way passage,' by which communication may be established under certain conditions, between the main air-pipe or train-pipe, and hence might be held to meet the terms of the claim as originally broadly drawn, yet it fails to embody a device which in structure or function corresponds with the auxiliary valve of applicant, which in no sense relates to 'an always-open one-way passage.' This amended claim, above submitted, prescribes a valve device actuated by the piston of the triple-valve for admitting air to the brake-cylinder in the application of the brake, while Boyden's check-valve *d* is not actuated by the piston, and is designed to recharge the auxiliary reservoir and brake-cylinder while the brakes are on. It is submitted, as to claim 2, that a piston, which by its preliminary traverse, admits air from the auxiliary reservoir to the brake-cylinder and by its further traverse admits air directly from the main air-pipe to the brake-cylinder, as set forth in said claim, is not found in the Boyden patent, the check-valve *d* of which is described as actuated by the manipulation of the cock *q* on the locomotive to 'recharge and continue charging the reservoir and brake-cylinder while the brakes are applied.' . . . It is to be understood that applicant *does not seek to broadly claim a device for admitting air directly from the main air-pipe to the brake-cylinder*, as the four-way cock long heretofore employed by him (similar to the cock *K* of the Boyden patent) would be a structure of such character. When, however, the triple-valve is provided with an *auxiliary valve, operated by its piston which performs a new function* additional to that of the triple-valve as previously employed, it is believed that such *combination* is wholly novel."

So, too, in the specification it is stated:

"So far as the performance of its preliminary function in ordinary braking is concerned — that is to say, effecting the closure of communication between the main air-pipe and the auxiliary reservoir, and the opening of communication between the auxiliary reservoir and the brake-cylinder in applying the brakes, and the reverse operations in releasing the brakes — the triple-valve 10 accords substantially with that set forth in letters patent of the United States No. 220,556, granted and

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issued to me October 14, 1879, and is not, therefore, saving as to the *structural features* by which it performs the further function of effecting the direct admission of air from the main air-pipe to the brake-cylinder, as presently to be described, claimed as of my present invention."

Apparently, too, in consequence of the above letter of January 19, 1887, the patentee erased from his original specification the following sentence: "Further, while in the specific construction described and shown, the function of admitting air from the main pipe is performed by a valve separate from that which effects the preliminary admission of reservoir pressure to the cylinder, a modification in which the same office is performed by a valve integral with the main valve and formed by an extension thereof, would be included in and embody the essential operative features of my invention," and inserted in its place the following: "I am aware that a construction in which 'an always-open one-way passage' from the main air-pipe to the brake-cylinder is uncovered by the piston of the triple-valve simultaneously with the opening of the passage from the auxiliary reservoir to the brake-cylinder, has been heretofore proposed, and such construction, which involves an operation different from that of my invention, I therefore hereby disclaim."

We agree with the defendant that this correspondence, and the specification as so amended, should be construed as reading the auxiliary valve into the claim, and as repelling the idea that this claim should be construed as one for a method or process. Language more explicit upon this subject could hardly have been employed.

While it is true that no claim is formally made for the admission of train-pipe air directly to the brake-cylinder as a method or process, a construction is given by the complainants and the Circuit Court to the second claim which eliminates the mechanical features described, and one which could only be supported upon the theory that the claim was for a method or process. If the mechanism described by Westinghouse, and particularly the auxiliary valve, be not essential to the validity of the second claim, then it could only be supported

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upon the theory that it was for the process of admitting train-pipe air directly to the brake-cylinder.

2. The first and fourth claims of this patent are as follows :

"1. In a brake mechanism, the combination of a main air-pipe, an auxiliary reservoir, a brake-cylinder, a triple-valve and an auxiliary valve device, actuated by the piston of the triple-valve and independent of the main valve thereof, for admitting air in the application of the brake directly from the main air-pipe to the brake-cylinder, substantially as set forth."

"4. The combination, in a triple-valve device, of a case or chest, a piston fixed upon a stem and working in a chamber therein, a valve moving with the piston-stem and governing ports and passages in the case leading to connections with an auxiliary reservoir and a brake-cylinder and to the atmosphere, respectively, and an auxiliary valve actuated by the piston-stem and controlling communication between passages leading to connections with a main air-pipe and with the brake-cylinder, respectively, substantially as set forth."

These two claims are practically little more than different expressions of one and the same invention. In both of them there is a main air-pipe, an auxiliary reservoir, a brake-cylinder, a triple-valve and piston, described in the fourth claim as "fixed upon a stem and working in a chamber" in a case or chest, and an auxiliary valve; and in the fourth claim also a case or chest, which contains the whole device and is immaterial.

In both of these claims an auxiliary valve is named as an element. In the first it is described as "actuated by the piston of the triple-valve and independent of the main valve thereof;" and in the fourth as "actuated by the piston-stem and controlling communication between passages leading to connections with the main air-pipe and with the brake-cylinder."

To what liberality of construction these claims are entitled depends to a certain extent upon the character of the invention, and whether it is what is termed in ordinary parlance a "pioneer." This word, although used somewhat loosely, is commonly understood to denote a patent covering a function

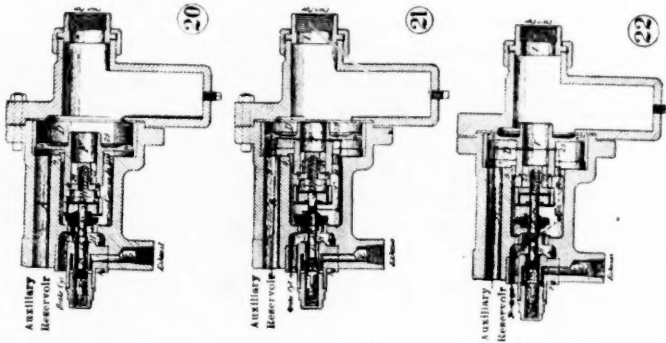
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never before performed, a wholly novel device, or one of such novelty and importance as to mark a distinct step in the progress of the art, as distinguished from a mere improvement or perfection of what had gone before. Most conspicuous examples of such patents are: The one to Howe of the sewing machine; to Morse of the electrical telegraph; and to Bell of the telephone. The record in this case would indicate that the same honorable appellation might be safely bestowed upon the original air-brake of Westinghouse, and perhaps also upon his automatic brake. In view of the fact that the invention in this case was never put into successful operation, and was to a limited extent anticipated by the Boyden patent of 1883, it is perhaps an unwarrantable extension of the term to speak of it as a "pioneer," although the principle involved subsequently and through improvements upon this invention became one of great value to the public. The fact that this invention was first in the line of those which resulted in placing it within the power of an engineer, running a long train, to stop in about half the time and half the distance within which any similar train had stopped, is certainly deserving of recognition, and entitles the patent to a liberality of construction which would not be accorded to an ordinary improvement upon prior devices. At the same time, as hereinafter observed, this liberality must be exercised in subordination to the general principle above stated: that the function of a machine cannot be patented, and, hence, that the fact that the defendants' machine performs the same function is not conclusive that it is an infringement.

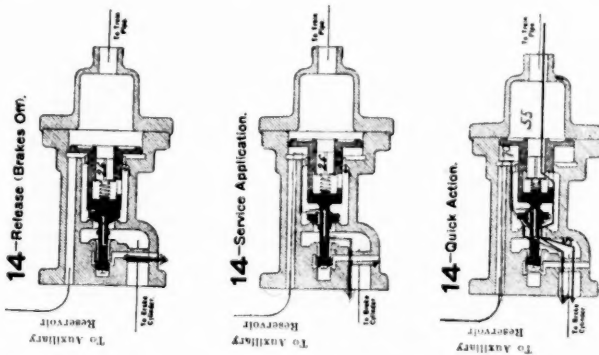
The device made use of by the defendants is exhibited in patents No. 481,134 and No. 481,135, both dated August 16, 1892, and both of which were granted after the commencement of this suit. There are two forms of this patent, one of which, illustrated in patent No. 481,135, is here given on the opposite page in its three positions of release (20), service application (21), and quick action (22).

In this device there is found a main air-pipe, an auxiliary reservoir, a brake-cylinder, a triple, or rather a quadruple, valve and piston (29) with three ports; first, for the admission

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of air from the train-pipe to the brake-cylinder through the feeding-in valve 26; second, for the passage of air from the auxiliary reservoir to the brake-cylinder through the apertures *i, j, k* in the stem slide-valve 18; and, third, for the release of air from the brake-cylinder to the exhaust port by means of valve 17, colored green. Whether this device has an auxiliary valve or not is one of the main questions in the case, complainants' theory being that poppet-valve 22 is an auxiliary valve, while defendants' claim is that it is in reality the main valve.



The operation of this device is best shown by the foregoing skeleton drawings.

The auxiliary reservoirs are charged by air under pressure,

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entering from the train-pipe, raising and passing through the feeding-in valve piston 26, and flowing slowly into and through the passage A to the auxiliary reservoir, until such reservoir is filled. In this condition the brake-cylinder is emptied and opened to the atmosphere through the exhaust passage G.

In order to apply the brakes gradually, so as to slacken speed or make an ordinary stop, air pressure in the train-pipe is reduced slightly (say from three to five pounds) by action of the engineer's valve, and the reduction of pressure on the right side of the piston 29 causes the piston to make what is termed a "preliminary traverse" to the position shown in diagram "Service Application." Such preliminary traverse pulls the stem slide-valve 18 to the right, and opens the apertures *i*, *j* and *k*, (one of these apertures being to the right and the other to the left of valve 22,) and through these apertures air rushes from the auxiliary reservoir to the brake-cylinder; but the poppet-valve 22 still remains upon its seat.

If quick action be required, the pressure in the train-pipe is suddenly lowered to the extent of fifteen or twenty pounds, and the travelling piston 29, instead of making a preliminary traverse to the intermediate position shown in the "Service Application," makes a full traverse to the extreme right, the effect of which is that the valve 22 is pulled off its seat by the collar M, and a large passage is opened to the brake-cylinder under the valve 22 and around the stem 18. The result is, as shown in the last diagram, that not only does the air in the auxiliary reservoir escape in full volume to the brake-cylinder, but air from the train-pipe rushes directly to the brake-cylinder through the large passage F into the chamber C and under valve 22.

The argument of the defendants in this connection is that, in this device, there is no auxiliary valve or by-passage, but the quick-action result is effected simply by proportioning the ports and passages of the old triple-valve, and using a fixed partition, 9, to divide the piston chamber D from the main-valve chamber C; that it is this partition which produces the quick action, and that such partition is not a valve, nor the mechanical equivalent of a valve, but merely a metal ring

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screwed immovably into the triple-valve casing, and serving to divide the piston-chamber from the main-valve chamber; that this partition was a new element, never before found in triple valves, and introduced a new principle and mode of operation, totally different from anything ever invented by Mr. Westinghouse or any other inventor, and that its effect is to make valve 22, termed by them the main valve, admit the train-pipe air to the brake-cylinder at the same time that it admits the auxiliary air thereto.

It is claimed that, in embodying this new principle, Mr. Boyden adopted the form of triple-valve shown in the expired Westinghouse patent No. 141,685, (1873,) in which the main valve, 22, is of the poppet form, and the separate valve 17, controlled by a rod sliding through the main valve, is employed for releasing the brakes. For charging the auxiliary reservoir he adopted, from the expired Westinghouse patent No. 144,006, (1873,) a check-valved feed passage through the triple-valve piston, but arranged the feed passage and its check-valve, 26, in a tubular extension, F, of the piston, and substantially in the form shown in Boyden patent No. 280,285, (1883). He also provided a sensitive graduating valve, similar in results to the graduating valve *e'* of the Westinghouse patent No. 220,556, (1879,) by so arranging a small passage, 40, in the sliding stem, which actuates the release valve, that such passage will be opened and closed by the sliding of such stem through the main valve 22. As thus constructed, the triple-valve operates much the same as that of patent No. 220,556, and, like the latter, is incapable of quick action.

In both the complainants' and defendants' devices there is: (1) a feeding-in valve to charge the auxiliary reservoir; (2) a valve which complainants call their "main valve," and which the defendants denominate a "graduating valve," which is opened by the preliminary traverse of the piston to admit reservoir air to the brake-cylinder; (3) a release valve which discharges air from the brake-cylinder to the atmosphere; and (4) a quick-action valve — 41 in the complainants' patent, and 22 in the defendants' — which is opened by the further traverse of the piston to admit train-pipe air to the brake-

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cylinder. In defendants' patent, it may also be used to admit auxiliary reservoir air to the brake-cylinder.

One of the main controversies in the case turns upon the construction and operation of the poppet-valve 22, called by the defendants their "main-valve." Complainants insist that the office of *their* main valve is performed by the stem slide-valve 18 of defendants' patent, and by its apertures *i, j* and *k*, through which air passes from the auxiliary reservoir to the brake-cylinder, and that the poppet-valve 22 is only called into action in emergency cases, when a large quantity of air is suddenly withdrawn from the train-pipe, and the valve is unseated by the traverse of the piston to the extreme right.

There is no doubt that the function of admitting air from the auxiliary reservoir to the brake-cylinder, which is performed in the Westinghouse patent by what the complainants term the main-valve, (aided, however, by the graduating-valve,) is, in ordinary cases, performed principally, if not altogether, by the stem slide-valve 18 and its three ports *i, j, k*, of the Boyden patent, which defendants term their graduating-valve. It is equally clear that, in emergencies, where quick action is required, air, which in the Westinghouse patent passes through auxiliary valve 41, (opened by the further traverse of the piston,) in the Boyden patent finds its way through the poppet-valve 22, which has also been lifted from its seat by the further traverse of the piston.

One of the main differences between the two devices is this: That in the preliminary traverse of the piston of the Westinghouse patent, there is a movement, first, of the graduating-valve to open its port from the auxiliary reservoir, and then of the main valve, carrying the graduating-valve also with it, to open a passage to the brake-cylinder, while in the Boyden patent it is only the graduating-valve which is opened by the preliminary traverse of the piston. In doing this, the graduating-valve moves *through* the poppet-valve, but does not lift it from its seat. In emergency cases not only do the graduating-valve and the main-valve of the Westinghouse patent move as before, but, by the extreme traverse of the piston, the auxiliary-valve 41 is shoved from its seat, and a separate

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passage is opened for the air from the train-pipe to the brake-cylinder. In the Boyden patent, however, the extreme traverse of the piston lifts the poppet-valve from its seat, and opens a wide passage to the brake-cylinder, not only for the air from the auxiliary reservoir, but, through the peculiar operation of the partition 9 and its aperture B, directly from the train-pipe. As the graduating-valve of the Boyden patent practically does all the work in ordinary cases, and the poppet-valve is only called into action in emergency cases, the latter is practically an auxiliary valve, by which, we understand, not necessarily an independent valve, nor one of a particular construction, but simply a valve which in emergency cases is called into the assistance of the graduating-valve. In this particular, the poppet-valve of the Boyden device performs practically the same function as the slide-valve 41 of the Westinghouse. It is not material in this connection that it is a poppet-valve while the other is a slide-valve, since there is no invention in substituting one valve or spring of familiar shape for another; *Imhaeuser v. Buerk*, 101 U. S. 647, 656; nor, that in one case the piston *pushes* the valve off its seat, and in the other *pulls* it off; nor is it material that this poppet-valve may have been used in prior patents to perform the function of a main-valve, so long as it is used for a different purpose here. Indeed, this valve seems to have been taken bodily from Westinghouse patent No. 141,685, where it was used as a main-valve, and the stem-valve 18 with its ports *i*, *j*, *k*, added for ordinary uses, and the poppet-valve thus converted from a main-valve to an auxiliary valve.

We have not overlooked in this connection the argument that the poppet-valve 22 is also sometimes used for graduating purposes, but it is not commonly so used, and appears to be entirely unnecessary for that purpose. It seems to be possible to move the piston 29 to its extreme traverse so slowly, and hence to open valve 22 so gradually, that the pressure in the chamber C will be reduced so slightly, that the train-pipe air will not have sufficient force to throw open the check-valve 26, and hence, in such case no train-pipe air will be admitted directly to the brake-cylinder, which will be filled with auxil-

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iary reservoir air only. But, as a matter of fact, this seldom or never takes place in the practical operation of the device, and is an unnecessary and wholly unimportant incident, and for all practical purposes valve 22 is solely a quick-action valve. As this valve is actuated by the piston of the triple-valve, and in such action is independent of the main valve, it meets the demand of the first claim of the patent, and as it is actuated by the piston-stem, and controls communication between passages leading to connections with the main air-pipe and with the brake-cylinder, it seems also to be covered by the fourth claim.

But even if it be conceded that the Boyden device corresponds with the letter of the Westinghouse claims, that does not settle conclusively the question of infringement. We have repeatedly held that a charge of infringement is sometimes made out, though the letter of the claims be avoided. *Machine Co. v. Murphy*, 97 U. S. 120; *Ives v. Hamilton*, 92 U. S. 426, 431; *Morey v. Lockwood*, 8 Wall. 230; *Elizabeth v. Pavement Company*, 97 U. S. 126, 137; *Sessions v. Romadka*, 145 U. S. 29; *Hoyt v. Horne*, 145 U. S. 302. The converse is equally true. The patentee may bring the defendant within the letter of his claims, but if the latter has so far changed the principle of the device that the claims of the patent, literally construed, have ceased to represent his actual invention, he is as little subject to be adjudged an infringer as one who has violated the letter of a statute has to be convicted, when he has done nothing in conflict with its spirit and intent. "An infringement," says Mr. Justice Grier in *Burr v. Duryee*, 1 Wall. 531, 572, "involves substantial identity, whether that identity be described by the terms, 'same principle,' same '*modus operandi*,' or any other. . . . The argument used to show infringement assumes that every combination of devices in a machine which is used to produce the same effect, is necessarily an equivalent for any other combination used for the same purpose. This is a flagrant abuse of the term 'equivalent.'"

We have no desire to qualify the repeated expressions of this court to the effect that, where the invention is functional, and the defendant's device differs from that of the patentee

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only in form, or in a rearrangement of the same elements of a combination, he would be adjudged an infringer, even if, in certain particulars, his device be an improvement upon that of the patentee. But, after all, even if the patent for a machine be a pioneer, the alleged infringer must have done something more than reach the same result. He must have reached it by substantially the same or similar means, the rule that the function of a machine cannot be patented is of no practical value. To say that the patentee of a pioneer invention for a new mechanism is entitled to every mechanical device which produces the same result is to hold, in other language, that he is entitled to patent his function. Mere variations of form may be disregarded, but the substance of the invention must be there. As was said in *Burr v. Duryee*, 1 Wall. 531, 573, an infringement "is a copy of the thing described in the specification of the patentee, either without variation, or with such variations as are consistent with its being in substance the same thing. If the invention of the patentee be a machine, it will be infringed by a machine which incorporates in its structure and operation the substance of the invention; that is, by an arrangement of mechanism which performs the same service or produces the same effect in the same way, or substantially the same way. . . . That two machines produce the same effect will not justify the assertion that they are substantially the same, or that the devices used are, therefore, mere equivalents for those of the other."

Not only is this sound as a general principle of law, but it is peculiarly appropriate to this case. Under the very terms of the first and fourth claims of the Westinghouse patent, the infringing device must not only contain an auxiliary valve, or its mechanical equivalent, but it must contain the elements of the combination "substantially as set forth." In other words, there must not only be an auxiliary valve, but substantially such a one as is described in the patent, *i.e.* independent of the triple-valve. Not only has the Boyden patent a poppet instead of a slide-valve—a matter of minor importance—but it performs a somewhat different function. In the Westinghouse patent the valve is not in the line of travel between the

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auxiliary reservoir and the brake-cylinder, and admits train-pipe air only. In the Boyden patent, it is in the line of travel, both from the auxiliary reservoir and from the train-pipe, and admits both currents of air to the brake-cylinder. The by-passage, to which the auxiliary reservoir is merely an adit, is wholly wanting in the Boyden device, both currents of air uniting in chamber C and passing to the brake-cylinder together, through the poppet-valve.

But a much more radical departure from the Westinghouse patent is found in the partition 9, separating the valve-chamber C from the piston-chamber D. This partition has an aperture, B, the capacity of which is less than that of the large passage A, and intermediate in size between that of the graduating passage 40, and that of the port covered by the valve 22. The office of this partition is thus explained by the defendants in their briefs: When the engineer's valve is thrown wide open, the poppet-valve is lifted from its seat by the extreme traverse of the piston, and a new action takes place. "The port of the main valve 22 is so much larger than the passage B, that the pressure in the main valve-chamber C is instantly emptied into the brake-cylinder, and, as the passage B cannot supply air so fast as the main-valve port can exhaust it, the pressure in the main valve-chamber suddenly drops to about five pounds. Meanwhile the passage A, leading from the auxiliary reservoir to the inner end of the piston-chamber, is so much larger than the passage B, leading from the piston-chamber to the main valve-chamber, that full reservoir pressure is maintained in the piston-chamber between the partition 9 and the inner side of the piston, thereby holding the piston back firmly at its extreme traverse. But the feed-valve 26 is now exposed on the one side to a train-pipe pressure of about fifty-five pounds, and on the other side to a main valve-chamber pressure of only about five pounds, and therefore valve 26 is instantly forced open by the greater train-pipe pressure, which then vents freely through the said feed valve-port into the main valve-chamber C where it commingles with the auxiliary reservoir air passing through said chamber, and both airs pass together through the port opened by the main valve 22

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to the brake-cylinder. The whole operation is substantially instantaneous, and the result is that the train-pipe is freely vented at each car, the time of serially or successively applying the brakes of the several cars from one end of the train to the other is reduced to a minimum, and the train is quickly stopped without shock, a result which Mr. Westinghouse did not attain with the device of patent No. 360,070, nor did he attain it until he had invented his later apparatus of patent No. 376,837, not here in suit."

In a word, this partition maintains upon the outside of valve 26 a much higher pressure than upon the inside, the effect of which is to open feed-valve 26 and admit a full volume of train-pipe air upon the brake-cylinder.

Conceding that the functions of the two devices are practically the same, the means used in accomplishing this function are so different that we find it impossible to say, even in favor of a primary patent, that they are mechanical equivalents. While the poppet-valve, which for the purposes of this case, we may term the auxiliary valve, is in its operation independent of the main valve, the word "independent" in the claims of the Westinghouse patent evidently refers to a valve auxiliary to the triple-valve, and independently located as well as operated. The difference is that in one case the air from the train-pipe is introduced into the brake-cylinder separately and independently from the air from the auxiliary reservoir; while in the other case they unite in the chamber C and pass through the same valve to the brake-cylinder. In the Westinghouse patent there is one valve operated by the direct thrust of the piston, opening a by-passage; in the other, there is a poppet-valve also opened by the piston, and another valve, 26, opened by the pressure maintained upon the outside of the partition 9.

It is claimed, however, by the complainants that Boyden was not the inventor of the differential pressure theory; that there is such a differential pressure in their own patent, caused by the fact that the air from the auxiliary reservoir in passing to the brake-cylinder travels through a restricted port, 35, and, as the entrance to the brake-cylinder is through a much larger port, the air is taken up by it much more rapidly than it is

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supplied by the restricted port, which reduces the pressure in the by-passage so much that when the quick-action valve 41 is opened, the pressure from the train-pipe air is sufficient to open the valve 49 and admit a full volume of train-pipe air, at a pressure of fifty-five pounds, to the brake-cylinder. The fact, however, that no suggestion is made in the patent of such a function of the restricted port 35, indicates either that none such had been discovered, or that it was not considered of sufficient importance to mention it. Indeed, it seems to have been an afterthought, suggested by the necessity of an answer to defendants' argument, based upon their partition 9. That when the auxiliary valve is opened there must be a difference in pressure above and below the check-valve 49, in order to open it, is manifest; yet, this is rather an incident to the Westinghouse device than the controlling feature that it is made in the Boyden patent. There is no partition in the proper sense of the word — certainly none located as in the Boyden device — between the chambers D and C, and no aperture in such partition opened for the express purpose of maintaining this differential pressure. If such differential pressure existed to the extent claimed in the Westinghouse patent, it certainly was not productive of the results flowing from the same device in the Boyden patent.

We are induced to look with more favor upon this device, not only because it is a novel one and a manifest departure from the principle of the Westinghouse patent, but because it solved at once in the simplest manner the problem of quick action, whereas the Westinghouse patent did not prove to be a success until certain additional members had been incorporated into it. The underlying distinction between the two devices is that in one, a separate valve and separate by-passage are provided for the train-pipe air, while in the other, the patentee has taken the old triple (or quadruple) valve, and by a slight change in the functions of two of its valves and the incorporation of a new element, (partition 9,) has made a more perfect brake than the one described in the Westinghouse patent. If credit be due to Mr. Westinghouse for having invented the function, Mr. Boyden has certainly exhibited

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great ingenuity in the discovery of a new and more perfect method of performing such function. If his patent be compared with the later Westinghouse patent No. 376,837, which appears to have been the first completely successful one, the difference between the two, both in form and principle, becomes still more apparent, and the greater simplicity of the Boyden patent certainly entitles it to a favorable consideration. If the method pursued by the patentee for the performance of the function discovered by him would naturally have suggested the device adopted by the defendants, that is in itself evidence of an intended infringement; but, although Mr. Boyden may have intended to accomplish the same results, the Westinghouse patent, if he had had it before him, would scarcely have suggested the method he adopted to accomplish these results. Under such circumstances, the law entitles him to the rights of an independent inventor.

Upon a careful consideration of the testimony we have come to the conclusion that the Boyden device is not an infringement of the complainants' patent, and the decree of the Circuit Court of Appeals is, therefore,

Affirmed.

MR. JUSTICE SHIRAS, with whom concurred MR. JUSTICE BREWER, dissenting.

I am unable to concur in the reasoning and conclusion of the court, and shall briefly state my views.

The history of the art discloses that the patent in suit was what is called a "pioneer invention." In it, for the first time, was brought to light a method or process which, by the co-operation of the air from the train-pipe with that from the car reservoir, created the "quick action" brake. The patent, in its specification and claims, clearly described a machine or mechanical combination whereby the invention was exemplified or rendered operative.

It is not an unwarrantable extension of the term to speak of this invention in suit as a pioneer, since it is practically conceded in this case, and justly observed by the court below,

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"one of the highest value to the public," and conspicuously one "which entitles the proprietor to a liberal protection from the courts in construing the claim." The very fact that this invention resulted in placing it within the power of an engineer, running a long train, to stop in about half the time and half the distance within which any similar train had been stopped, is certainly deserving of recognition. The claims of such patents have from time out of mind been allowed a liberal construction, and considered as entitled to the fullest benefit of the doctrine of mechanical equivalents.

It in nowise detracts from the merit of this invention that later devices have been adopted which render its practical operation more efficient. The very term, "pioneer patent," signifies that the invention has been followed by others. A pioneer patent does not shut, but opens the door for subsequent invention.

The particular patent in suit was, as I understand it to be admitted, an entire success in supplying passenger trains and short freight trains with a "quick action" brake; but while it enabled even the longest freight trains to stop in half the time and half the distance previously occupied, there remained difficulties which required further devices to give to the invention the perfect success which it has now attained.

Being of the character so described as a pioneer, the patent in suit is entitled to a broad or liberal construction. In other words, the invention is not to be restricted narrowly to the mere details of the mechanism described as a means of carrying the invention into practicable operation.

I cannot assent to what is, perhaps, rather intimated than decided in the opinion of the court that what is called a "process in order to be patentable must involve a chemical or other similar elemental action." The term "process" or "method," as describing the subject of a patent, is not found in the statutes. No reason is given in the authorities, and I can think of none in the nature of things, why a new process or method may not be patentable, even though a mechanical device or a mechanical combination may be necessary to render the new process practicable. It seems to be used by the courts

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as descriptive of an invention which, from its novelty and priority in the art to which it belongs, is not to be construed as inhering only in the particular means described, in the letters patent, as sufficient to exemplify the invention and bring it into practical use.

Thus in the case of *Winans v. Dormead*, 15 How. 330, 341, the patent was for a new form of the body of a car for the transportation of coal, thus avoiding certain practical difficulties or disadvantages in such cars as previously made. To the argument on behalf of the infringer, that the claim of the patent was confined to a single form, and only through and by that form to the principle which it embodies, this court said, per Mr. Justice Curtis:

"It is generally true that when a patentee describes a machine, and then claims it as described, he is understood to intend to claim, and does by law actually cover, not only the precise form he has described, but all other forms which embody his invention; it being a familiar rule that to copy the principle or mode of operation described is an infringement, although such copy should be totally unlike the original in form or proportions. . . . It is not sufficient to distinguish this case to say that here the invention consists in a change of form, and the patentee has claimed one form only. Patentable improvements in machinery are almost always made by changing some one or more forms of one or more parts, and thereby introducing some mechanical principle or mode of action not previously existing in the machine, and so securing a new or improved result. And in the numerous cases in which it has been held that to copy the patentee's mode of operation was an infringement, the infringer had got forms and proportions not described, and not in terms claimed. If it were not so, no question of infringement could arise. If the machine complained of were a copy, in form, of the machine described in the specification, of course, it would be at once seen to be an infringement. It could be nothing else. It is only ingenious diversities of form and proportion, presenting the appearance of something unlike the thing patented, which give rise to questions; and the property of inventors would be valueless

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if it were enough for the defendant to say: Your improvement consisted in a change of form; you describe and claim but one form; I have not taken that, and so have not infringed.

"The answer is: My infringement did not consist in a change of form, but in the new employment of principles or powers, in a new mode of operation, embodied in a form by means of which a new or better result is produced; it was this which constituted my invention; this you have copied, changing only the form. . . . Where form and substance are inseparable it is enough to look at the form only. Where they are separable — where the whole substance of the invention may be copied in a different form, it is the duty of courts and juries to look through the form for the substance of the invention — for that which entitled the inventor to his patent, and which the patent was designed to secure; where that is found there is an infringement; and it is not a defence that it is embodied in a form not described and in terms claimed by the patentee. Patentees sometimes add to their claims an express declaration to the effect that the claim extends to the thing patented, however its form or proportions may be varied. But this is unnecessary. The law so interprets the claim without the addition of these words."

McCormick v. Talcott, 20 How. 402, 405, was also a case of a mechanical patent, and it was said by Mr. Justice Grier, who delivered the opinion of the court: If the patentee "be the original inventor of the device or machine, called the divider, he will have a right to treat as infringers all who make dividers operating on the same principle and performing the same functions by analogous means or equivalent combination, even though the infringing machine may be an improvement of the original and patentable as such."

In *Morley Sewing Machine Co. v. Lancaster*, 129 U. S. 263, there was also a question of an alleged invention of a primary character, and wherein the invention was embodied in a mechanical combination; and it was held that, in a pioneer patent, such as that of Morley, the patentee, the special devices set forth by Morley were not necessary constituents

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of the claims; that his patent was to receive a liberal construction, in view of the fact that he was a pioneer in the construction of an automatic button sewing machine, and that his patent was not to be limited to the particular devices or instrumentalities described by him.

In that case extended and approving reference was made to the case of *Proctor v. Bennis*, 36 Ch. Div. 740, which was a case of an invention embodied in a mechanical contrivance, and the following language of Lord Justice Bowen was quoted:

"Now I think it goes to the root of this case to remember that this is, as was described by one of the counsel, really a pioneer invention, and it is by the light of that, as it seems to me, that we ought to consider the question whether there have been variations, or omissions, and additions, which prevent the machine which is complained of from being an infringement of the plaintiff's. . . . With regard to the additions and omissions, it is obvious that additions may be an improvement, and that omissions may be an improvement, but the mere fact that there is an addition, or the mere fact that there is an omission, does not enable you to take the substance of the plaintiff's patent. The question is not whether the addition is material, or whether the omission is material, but whether what has been taken is the substance and essence of the invention."

These were cases wherein the discovery or invention was made effective through machines or mechanical combinations, and wherein it was held that the merit of the process or method was not to be confined, in the case of a pioneer patent, to the mere form described in the specification as sufficient to make the invention practically operative.

Neilson's patent, Web. P. C. 275, was a noted case, in which the true distinction was drawn between a mere principle, as the subject of a patent, and a process by which a principle is applied to effect a new and useful result. The Court of Exchequer, in answering the objection that Neilson's patent was for a principle, said:

"It is very difficult to distinguish it from the specification

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of a patent for a principle, and this at first created in the minds of some of the court much difficulty; but after full consideration, we think the plaintiff does not merely claim a principle, but a machine embodying a principle, and a very valuable one. We think the case must be considered as if the principle being well known, the plaintiff had first invented a mode of applying it by a mechanical apparatus to furnaces; and his invention consists in this — by interposing a receptacle for heated air between the blowing apparatus and the furnace. In this receptacle he directs the air to be heated by the application of heat externally to the receptacle, and thus he accomplishes the object of applying the blast, which was before of cold air, in a heated state to the furnace."

And when the case came before the House of Lords, Lord Campbell said:

"After the construction first put upon the patent by the learned judges of the Exchequer, . . . I think the patent must be taken to extend to all machines, of whatever construction, whereby the air is heated intermediately between the blowing apparatus and the blast furnace. That being so, the learned judge was perfectly justified in telling the jury that it was unnecessary for them to compare one apparatus with another, because, confessedly, that system of conduit pipes was a mode of heating air by an intermediate vessel between the blowing apparatus and the blast furnace, and, therefore, it was an infringement of the patent." Web. Pat. Cas. 715.

Very applicable to the present case is the doctrine of *Tilghman v. Procter*, 102 U. S. 707. It was there held, overruling the case of *Mitchell v. Tilghman*, 19 Wall. 287, that a patent may be validly granted for carrying a principle into effect; and if the patentee suggests and discovers not only the principle, but suggests and invents how it may be applied to a practical result by mechanical contrivances and apparatus, and shows that he is aware that no particular sort or modification of form of apparatus is essential to obtain benefit from the principle, then he may take his patent for the mode

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of carrying it into effect, and is not under the necessity of confining himself to one form of apparatus.

Having discussed the previous cases, particularly that of *Neilson* and of *O'Reilly v. Morse*, 15 How. 62, Mr. Justice Bradley said:

"Whoever discovers that a certain useful result will be produced in any art by the use of certain means is entitled to a patent for it, provided he specifies the means.' But everything turns on the force and meaning of the word 'means.' It is very certain that the means need not be a machine, or an apparatus; it may, as the court says, be a process. A machine is a thing. A process is an act, or a mode of acting. The one is visible to the eye — an object of perpetual observation. The other is a conception of the mind, seen only by its effects when being executed or performed. Either may be the means of producing a useful result. . . . Perhaps the process is susceptible of being applied in many modes and by the use of many forms of apparatus. The inventor is not bound to describe them all in order to secure to himself the exclusive right to the process, if he is really its inventor or discoverer. But he must describe some particular mode, or some apparatus, by which the process can be applied with at least some beneficial result, in order to show that it is capable of being exhibited and performed in actual experience."

The Telephone cases, 126 U. S. 1, 532, 533, 535, contain an apt illustration of these principles. Mr. Chief Justice Waite in discussing the case, said:

"In this art, or, what is the same thing under the patent law, this process, this way of transmitting speech, electricity, one of the forces of nature, is employed; but electricity, left to itself, will not do what is wanted. The art consists in so controlling the force as to make it accomplish the purpose. It had long been believed that if the vibrations of air caused by the voice in speaking could be reproduced at a distance by means of electricity, the speech itself would be reproduced and understood. How to do it was the question. Bell discovered that it could be done by gradually changing the intensity of a continuous electric current, so as to make it

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correspond exactly to the changes in the density of the air caused by the sound of the voice. This was his art. He then devised a way in which these changes of density could be made and speech actually transmitted. Thus his art was put in a condition for practical use. In doing this, both discovery and invention, in the popular sense of those terms, were involved; discovery in finding the art, and invention in devising the means of making it useful. For such discoveries and such inventions the law has given the discoverer and inventor the right to a patent—as discoverer, for the useful art, process, method of doing a thing he has found; and as inventor, for the means he has devised to make the discovery one of actual value. . . . The patent for the art does not necessarily involve a patent for the particular means employed for using it. Indeed, the mention of any means, in the specification or descriptive portion of the patent, is only necessary to show that the art can be used; for it is only useful arts—arts which may be used to advantage—that can be made the subject of a patent. The language of the statute is that ‘any person who has invented or discovered any new and useful art, machine, manufacture or composition of matter,’ may obtain a patent therefor. Rev. Stat. § 4886. Thus, an art—a process—which is useful, is as much the subject of a patent, as a machine, manufacture or composition of matter. . . . But it is insisted that the claim cannot be sustained, because when the patent was issued Bell had not in fact completed his discovery. While it is conceded that he was acting on the right principles, and had adopted the true theory, it is claimed that the discovery lacked that practical development which was necessary to make it patentable. In the language of counsel, ‘there was still work to be done, and work calling for the exercise of the utmost ingenuity, and calling for the very highest degree of practical invention.’ It is quite true that when Bell applied for his patent he had never actually transmitted telegraphically spoken words so that they could be distinctly heard and understood at the receiving end of his line, but in his specification he did describe, accurately and with admirable clearness, his process, that is to say, the

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exact electrical condition that must be created to accomplish his purpose, and he also described with sufficient precision to enable one of ordinary skill in such matters to make a form of apparatus which, if used in the way pointed out, would produce the required effect, receive the words, and carry them to and deliver them at the appointed place. The particular instrument which he had and which he used in his experiments did not, under the circumstances in which it was tried, reproduce the words spoken so that they could be clearly understood, but the proof is abundant and of the most convincing character that other instruments, carefully constructed and made exactly in accordance with the specification, without any additions whatever, have operated and will operate successfully. . . . The law does not require that a discoverer or inventor, in order to get a patent for a process, must have succeeded in bringing his art to the highest degree of perfection. It is enough if he describes his method with sufficient clearness and precision to enable those skilled in the matter to understand what the process is, and if he points out some practicable way of putting it into operation. . . . Surely a patent for such a discovery is not to be confined to the mere means he improvised to prove the reality of his conception."

The conclusion justified by the authorities is that whether you call Westinghouse's discovery, that "quick action" may be accomplished by the coöperation of the main pipe air and that from the car reservoir, a process, or a mode of operation, yet if he was the first to disclose it and to describe a mechanical means to give practical effect to the invention, he must be regarded as a pioneer inventor, and as entitled to protection against those who, availing themselves of the discovery, seek to justify themselves by pointing to mere differences in form in the mechanical devices used.

Much stress was laid in the argument on an alleged disclaimer by the patentee while the application was pending in the Patent Office, whereby it is said Westinghouse must be understood to have abandoned the second claim, or, at any rate, to have consented that that claim should be interpreted

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by the courts as if it contained an auxiliary valve as a material element in the claim.

There are cases, no doubt, in which it has been held that when a claimant has, under objection in the Patent Office, withdrawn certain claims, or has modified them by adding or striking out terms or phrases, and accepts a patent which does not grant the abandoned or unmodified claims, he cannot be heard to insist upon such a construction of the allowed claims as would cover what had been previously rejected. *Shepard v. Carrigan*, 116 U. S. 593; *Roemer v. Peddie*, 132 U. S. 313; *Corbin Cabinet Lock Co. v. Eagle Lock Co.*, 150 U. S. 38.

An examination of the cited cases, however, will disclose, as I think, that they turned upon matters of construction. In other words, were cases where it was questionable what the patent, as actually granted, meant. In such cases, as in other cases of ambiguity, it may be allowable to consult the application and file wrapper, and possibly written communications, which may throw light upon claims that are ambiguous or capable of different constructions.

But where the claims allowed are not uncertain or ambiguous, the courts should be slow to permit their construction of a patent, actually granted and delivered, to be affected or controlled by alleged interlocutions between the officers in the Patent Office and the claimant. No doubt, in proceedings to revoke or cancel a patent granted by inadvertence or by fraudulent representations, it would be competent to show what had taken place in the Patent Office pending the application. But when we consider that often the employés in the Patent Office are inexperienced persons, and that the mass of the business is so vast that it is impossible for the Commissioner or the Chief Examiner to review it, except in a perfunctory way, it can be readily seen how dangerous it would be to modify or invalidate a patent, clear and definite in its terms, by resorting to such uncertain sources of information.

However this may be, I do not perceive that the matters alleged in the present case are entitled to any weight in the construction of the patent. Even if the letter of the claimant's attorney, written on January 19, 1887, can be looked to

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as helping us to understand the meaning of a patent granted on March 29, 1887, it only appears to be an argument as to the meaning or legal effect of the language used in the claims, and does not amount to a withdrawal or modification of them.

Accordingly the second claim of the patent is before us for construction on its own terms, and, to avoid protracting this discussion, the opinion of Judge Morris in the Circuit Court is referred to and adopted as a sound construction of that claim. 66 Fed. Rep. 997. This claim is not, as I read it, open to the objection that it aims to patent a principle. It sets forth the discovery that by a coöperation of the air from the auxiliary reservoir and that from the main air-pipe, the action of the brakes is quickened and the air vented from the main air-pipe directly to the brake-cylinder.

But, even if the second claim must, as argued in the opinion of the court, be read, by reason of the letter of the claimant's attorney, as if it called for the auxiliary valve described in the first and fourth claims, and even if, when not so read, it can be regarded as void because simply for a function or principle, nevertheless the invention, as described in the other claims and specifications, is clearly set forth, and, under the evidence as to the state of the art, is entitled to be regarded as a pioneer. Regarding the second claim as a mere statement of the idea or invention and the other claims as describing a form or combination of mechanism which embodies the invention and renders it operative, all the requisites of the law are sufficiently complied with.

The only remaining question is that of the infringement, and that is readily disposed of. For it is conceded in the opinion of the majority of the court that, if the patent in suit is entitled to a broad construction as a pioneer, embodying a new mode of operation, not limited to the particular means described in the specification, then the defendant's device is an adoption of the idea or principle of the Westinghouse patent with a mechanical equivalent or substitute for the auxiliary valve.

Upon the whole I am of the opinion that the decree of the

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Circuit Court of Appeals should be reversed and that the cause should be remanded with directions to restore the decree of the Circuit Court.

MR. JUSTICE GRAY and MR. JUSTICE MCKENNA also dissented from the opinion and from the decision of the court.
